

FEMA P-58 Fragility Specification

NISTIR Classification B1031.001
NISTIR Name Bolted shear tab gravity connections
Description Costing is on a per connection basis. Costing does not include fireproofing removal or reapplication cost.

Line 1

Construction Quality:	Not Specified				<div>Quantity Rounding</div> <div>Round Qty?</div> <div>YES</div> <div>Allow sum by floor or building?</div> <div>NO</div> <div>Demand Location (floor above?)</div> <div>No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Mutually Exclusive		Mutually Exclusive	Sequential	Sequential
DS Hierarchy	Seq(MutEx(DS1,DS2),DS3,DS4)				
Descriptions	Yielding of shear tab and elongation of bolt holes, possible crack initiation around bolt holes or at shear tab weld. Damage in field is either obscured or deemed to not warrant repair. No repair conducted.		Yielding of shear tab and elongation of bolt holes, possible crack initiation around bolt holes or at shear tab weld.	Partial tearing of shear tab and possibility of bolt shear failure (6-bolt or deeper connections).	Complete separation of shear tab, close to complete loss of vertical load resistance.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	0.95	0.05	1.00	1.00	
Fragility Parameters					
Median Demand, θ :	0.04	0.04	0.08	0.11	
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified	Not Specified	
Uncertainty, β_u :	0.4	0.4	0.4	0.4	
Total Dispersion, β :	0.4	0.4	0.4	0.4	
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Superior				
Data Relevance	Superior				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Careful inspection and welded repair to	Careful inspection and welded repair to	Repairs will include either welded repair	Repair will include complete	

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀			
Repair Cost by Damage State:	0.00E+00	0.00E+00	0.00E+00	6.05E+03	1.27E+04	1.76E+04	6.05E+03	1.30E+04	1.81E+04	6.05E+03	1.27E+04	1.82E+04						
Best fit mean:	0.00E+00			1.21E+04			1.24E+04			1.23E+04								
Best Fit Distribution:	LogNormal			Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	0.00E+00 0.00E+00			1.65E+04 1.02E+04			1.56E+04 1.10E+04			1.53E+04 1.08E+04								
CV or beta (Min Qty, Max Qty)	0.25 0.25			0.37 0.37			0.38 0.38			0.38 0.38								
Quantity Unit:	Each			Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀			
Repair Time by Damage State:	0.00E+00	0.00E+00	0.00E+00	5.87E+00	1.23E+01	1.70E+01	5.87E+00	1.26E+01	1.75E+01	5.87E+00	1.23E+01	1.76E+01						
Best fit mean:	0.00E+00			1.18E+01			1.20E+01			1.19E+01								
Best Fit Distribution:	LogNormal			Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	0.00E+00 0.00E+00			1.60E+01 9.88E+00			1.51E+01 1.07E+01			1.48E+01 1.05E+01								
CV or beta (Min Qty, Max Qty)	0.35 0.35			0.45 0.45			0.45 0.45			0.46 0.46								
Quantity Unit:	Each			Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		20%	0.50		10%	0.50							
Comments:																		
Date Created:																		
Approved (YES / NO)?																		
Official (YES / NO) ?																		
Author:																		
Revisions:																		

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

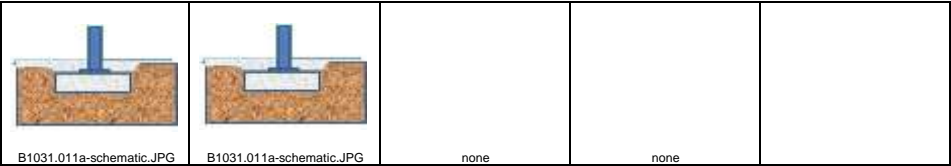
NISTIR Classification B1031.011a
NISTIR Name Steel Column Base Plates, Column W < 150 plf
Description Costing is on a per connection basis. Costing does not include fireproofing removal or reapplication cost.

Line 2

Construction Quality:	Not Specified				<div>Quantity Rounding</div> <div>Round Qty?</div> <div>YES</div> <div>Allow sum by floor or building?</div> <div>NO</div> <div>Demand Location (floor above?)</div> <div>No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio	Unit less			
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Mutually Exclusive		Mutually Exclusive		Sequential
DS Hierarchy	Seq(MutEx(DS1, DS2),DS3,DS4)				
Descriptions	Initiation of crack at the fusion line between the column flange and the base plate weld. Damage in field is either obscured or deemed to not warrant repair. No repair conducted.	Initiation of crack at the fusion line between the column flange and the base plate weld.	Propagation of brittle crack into column and/or base plate.	Complete fracture of the column (or column weld) and dislocation of column relative to the base.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	0.95	0.05	1.00	1.00
Fragility Parameters				
Median Demand, θ :	0.04	0.04	0.07	0.1
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified	Not Specified
Uncertainty, β_u :	0.4	0.4	0.4	0.4
Total Dispersion, β :	0.4	0.4	0.4	0.4
Correlation (Yes / No)	NO			
Directionality (Yes / No)	YES			
Quality Ratings				
Data Quality	Superior			
Data Relevance	Superior			
Documentation Quality	Superior			
Rationality	Superior			
Consequence Functions				
Repair Description				

The repair will involve removal of a portion of grade slab, gouging out material surrounding the fracture initiating and re-welding, then repair of slab. Field condition is deemed to not warrant repair by field observation. This Damage State is Mutually Exclusive with DS2. See fragility DS1 and DS2 probabilities.

The repair will involve removal of a portion of grade slab, gouging out material surrounding the fracture initiating and re-welding, then repair of slab.

Depending on the crack trajectory, the repair will range from replacement of a portion of the column or base plate to full replacement of the column base. Replacement will require shoring of column, torch cutting to remove damaged material, and fabrication and field welding to install replacement material.

Repair would likely involve replacing the entire base plate assembly and most of the column in the story above the base plate.

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	0.00E+00	0.00E+00	0.00E+00	1.12E+04	1.95E+04	3.23E+04	1.79E+04	2.62E+04	4.39E+04	2.23E+04	3.06E+04	5.09E+04			
Best fit mean:	0.00E+00			1.92E+04			2.73E+04			3.24E+04					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	0.00E+00 0.00E+00			2.54E+04 1.56E+04			3.15E+04 2.23E+04			3.67E+04 2.60E+04					
CV or beta (Min Qty, Max Qty)	0.25 0.25			0.41 0.41			0.37 0.37			0.34 0.34					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	0.00E+00	0.00E+00	0.00E+00	1.08E+01	1.89E+01	3.14E+01	1.74E+01	2.54E+01	4.26E+01	2.16E+01	2.97E+01	4.94E+01			
Best fit mean:	0.00E+00			1.87E+01			2.65E+01			3.15E+01					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	0.00E+00 0.00E+00			2.46E+01 1.51E+01			3.05E+01 2.16E+01			3.57E+01 2.53E+01					
CV or beta (Min Qty, Max Qty)	0.35 0.35			0.48 0.48			0.44 0.44			0.42 0.42					
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			NO			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			25% 0.50			10% 0.50					

Root Cost Multiplier: 1

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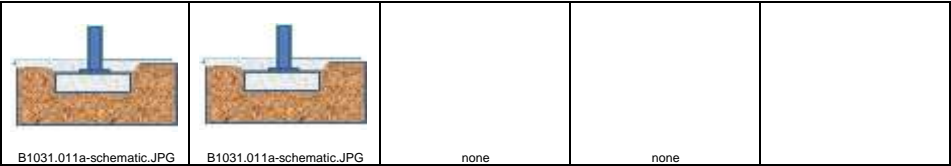
NISTIR Classification B1031.011b
NISTIR Name Steel Column Base Plates, Column 150 plf < W < 300 plf
Description Costing is on a per connection basis. Costing does not include fireproofing removal or reapplication cost.

Line 3

Construction Quality:	Not Specified				<div>Quantity Rounding</div> <div>Round Qty?</div> <div>YES</div> <div>Allow sum by floor or building?</div> <div>NO</div> <div>Demand Location (floor above?)</div> <div>No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Mutually Exclusive		Mutually Exclusive		
DS Hierarchy	Seq(MutEx(DS1, DS2),DS3,DS4)				
Descriptions	Initiation of crack at the fusion line between the column flange and the base plate weld. Damage in field is either obscured or deemed to not warrant repair. No repair conducted.	Initiation of crack at the fusion line between the column flange and the base plate weld.	Propagation of brittle crack into column and/or base plate.	Complete fracture of the column (or column weld) and dislocation of column relative to the base.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	0.95	0.05	1.00	1.00
Fragility Parameters				
Median Demand, θ :	0.04	0.04	0.07	0.1
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified	Not Specified
Uncertainty, β_u :	0.4	0.4	0.4	0.4
Total Dispersion, β :	0.4	0.4	0.4	0.4
Correlation (Yes / No)	NO			
Directionality (Yes / No)	YES			
Quality Ratings				
Data Quality	Superior			
Data Relevance	Superior			
Documentation Quality	Superior			
Rationality	Superior			
Consequence Functions				
Repair Description				

The repair will involve removal of a portion of grade slab, gouging out material surrounding the fracture initiating and re-welding, then repair of slab. Field condition is deemed to not warrant repair by field observation. This Damage State is Mutually Exclusive with DS2. See fragility DS1 and DS2 probabilities.

The repair will involve removal of a portion of grade slab, gouging out material surrounding the fracture initiating and re-welding, then repair of slab.

Depending on the crack trajectory, the repair will range from replacement of a portion of the column or base plate to full replacement of the column base. Replacement will require shoring of column, torch cutting to remove damaged material, and fabrication

Repair would likely involve replacing the entire base plate assembly and most of the column in the story above the base plate.

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	0.00E+00	0.00E+00	0.00E+00	1.20E+04	2.03E+04	3.31E+04	1.99E+04	2.82E+04	4.59E+04	2.63E+04	3.46E+04	5.49E+04			
Best fit mean:	0.00E+00			2.01E+04			2.94E+04			3.67E+04					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	0.00E+00 0.00E+00			2.64E+04 1.62E+04			3.39E+04 2.40E+04			4.15E+04 2.94E+04					
CV or beta (Min Qty, Max Qty)	0.25 0.25			0.39 0.39			0.34 0.34			0.31 0.31					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	0.00E+00	0.00E+00	0.00E+00	8.80E+00	1.49E+01	2.43E+01	1.46E+01	2.08E+01	3.38E+01	1.93E+01	2.55E+01	4.04E+01			
Best fit mean:	0.00E+00			1.48E+01			2.16E+01			2.70E+01					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	0.00E+00 0.00E+00			1.94E+01 1.19E+01			2.49E+01 1.76E+01			3.05E+01 2.16E+01					
CV or beta (Min Qty, Max Qty)	0.35 0.35			0.46 0.46			0.42 0.42			0.39 0.39					
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00		0%	0.00	
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00		0%	0.00	
Post-event Tagging Flag:	NO			NO			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		25%	0.50		10%	0.50				

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

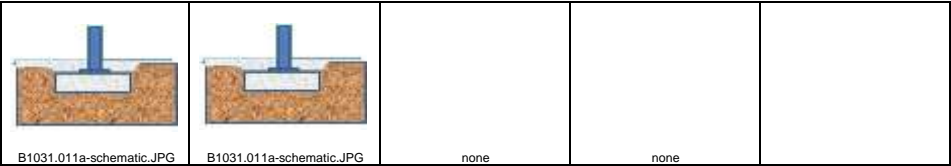
NISTIR Classification B1031.011c
NISTIR Name Steel Column Base Plates, Column W > 300 plf
Description Costing is on a per connection basis. Costing does not include fireproofing removal or reapplication cost.

Line 4

Construction Quality:	Not Specified				<div>Quantity Rounding</div> <div>Round Qty?</div> <div>YES</div> <div>Allow sum by floor or building?</div> <div>NO</div> <div>Demand Location (floor above?)</div> <div>No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Mutually Exclusive		Mutually Exclusive		
DS Hierarchy	Seq(MutEx(DS1, DS2),DS3,DS4)		Sequential		
Descriptions	Initiation of crack at the fusion line between the column flange and the base plate weld. Damage in field is either obscured or deemed to not warrant repair. No repair conducted.		Propagation of brittle crack into column and/or base plate.		Complete fracture of the column (or column weld) and dislocation of column relative to the base.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	0.95	0.05	1.00	1.00
Fragility Parameters				
Median Demand, θ :	0.04	0.04	0.07	0.1
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified	Not Specified
Uncertainty, β_u :	0.4	0.4	0.4	0.4
Total Dispersion, β :	0.4	0.4	0.4	0.4
Correlation (Yes / No)	NO			
Directionality (Yes / No)	YES			
Quality Ratings				
Data Quality	Superior			
Data Relevance	Superior			
Documentation Quality	Superior			
Rationality	Superior			
Consequence Functions				
Repair Description				

The repair will involve removal of a portion of grade slab, gouging out material surrounding the fracture initiating and re-welding, then repair of slab. Field condition is deemed to not warrant repair by field observation. This Damage State is Mutually Exclusive with DS2. See fragility DS1 and DS2 probabilities.

The repair will involve removal of a portion of grade slab, gouging out material surrounding the fracture initiating and re-welding, then repair of slab.

Depending on the crack trajectory, the repair will range from replacement of a portion of the column or base plate to full replacement of the column base. Replacement will require shoring of column, torch cutting to remove damaged material, and fabrication

Repair would likely involve replacing the entire base plate assembly and most of the column in the story above the base plate.

Long Lead Time (Yes / No) NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	0.00E+00	0.00E+00	0.00E+00	1.32E+04	2.15E+04	3.43E+04	2.29E+04	3.12E+04	4.89E+04	3.13E+04	3.96E+04	5.99E+04			
Best fit mean:	0.00E+00			2.14E+04			3.26E+04			4.19E+04					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	0.00E+00 0.00E+00			2.80E+04 1.72E+04			3.75E+04 2.65E+04			4.75E+04 3.37E+04					
CV or beta (Min Qty, Max Qty)	0.25 0.25			0.37 0.37			0.31 0.31			0.27 0.27					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	0.00E+00	0.00E+00	0.00E+00	8.72E+00	1.42E+01	2.27E+01	1.51E+01	2.07E+01	3.24E+01	2.07E+01	2.62E+01	3.97E+01			
Best fit mean:	0.00E+00			1.41E+01			2.16E+01			2.77E+01					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	0.00E+00 0.00E+00			1.85E+01 1.14E+01			2.48E+01 1.76E+01			3.15E+01 2.23E+01					
CV or beta (Min Qty, Max Qty)	0.35 0.35			0.45 0.45			0.40 0.40			0.37 0.37					
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Casualty-affected Planar Area (sf) per Normative Unit:	0%			0%			0%			0%					
Serious Injury (Median, Dispersion)	0%			0%			0%			0%					
Loss of Life (Median, Dispersion)	0%			0%			0%			0%					
Post-event Tagging Flag:	NO			NO			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0%			0%			25% 0.50			10% 0.50					

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Greg Deierlein
Revisions: 2016-06-27 Revise DS1 to be MutEx zero cost version of itself.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1031.021a
NISTIR Name Welded column splices, Column W < 150 plf
Description Costing is on a per connection basis. Costing does not include fireproofing removal or reapplication cost.

Line 5

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1		DS2		DS3
Type of Damage State:	Mutually Exclusive		Mutually Exclusive		Sequential
DS Hierarchy	Seq(MutEx(DS1,DS2),DS3)				
Descriptions	Ductile fracture of the groove weld flange splice. Damage in field is either obscured or deemed to not warrant repair. No repair conducted.		Ductile fracture of the groove weld flange splice.		DS1 followed by complete failure of the web splice plate and dislocation of the two column segments on either side of the splice.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	0.95	0.05	1.00		
Fragility Parameters					
Median Demand, θ :	0.02	0.02	0.05		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	0.4	0.4	0.4		
Total Dispersion, β :	0.4	0.4	0.4		

Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Superior				
Data Relevance	Superior				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Repair would involve gouging out the material adjacent to the fracture and repairing with a new groove weld. Field condition is deemed to not warrant repair by field observation. This Damage State is Mutually Exclusive with DS2. See fragility DS1 and DS2 probabilities.				
	Repair would involve gouging out the material adjacent to the fracture and repairing with a new groove weld.				
	Repair may not be practically feasible, but would require either realignment or replacement of adjacent column segments and rewelding of splice.				

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	0.00E+00	0.00E+00	0.00E+00	5.57E+03	9.34E+03	1.34E+04	7.57E+03	1.13E+04	1.65E+04						
Best fit mean:	0.00E+00			9.45E+03			1.12E+04								
Best Fit Distribution:	LogNormal			Normal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	0.00E+00 0.00E+00			1.21E+04 7.47E+03			1.36E+04 9.64E+03								
CV or beta (Min Qty, Max Qty)	0.25 0.25			0.32 0.32			0.30 0.30								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	0.00E+00	0.00E+00	0.00E+00	5.40E+00	9.07E+00	1.30E+01	7.34E+00	1.10E+01	1.60E+01						
Best fit mean:	0.00E+00			9.17E+00			1.09E+01								
Best Fit Distribution:	LogNormal			Normal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	0.00E+00 0.00E+00			1.18E+01 7.25E+00			1.32E+01 9.36E+00								
CV or beta (Min Qty, Max Qty)	0.35 0.35			0.41 0.41			0.39 0.39								
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			2% 0.50								

Comments: from weld root area.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Greg Deierlein
Revisions: 2015-07-28 revise DS1 and DS2 description and repair to align with FEMA P-38 BD-3.8.3 Page 23. 2016-06-27 Revise DS1 to be MutEx zero cost version of itself.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1031.021b
NISTIR Name Welded column splices, Column 150 plf < W < 300 plf
Description Costing is on a per connection basis. Costing does not include fireproofing removal or reapplication cost.

Line 6

Construction Quality:	Not Specified		
Seismic Installation Conditions:	Not Specified		
Fragility Unit of Measure:	EA 1		
Demand Parameter (unit):	Story Drift Ratio	Unit less	
Number of Damage States:	3		
Damage State:	DS1	DS2	DS3
Type of Damage State:	Mutually Exclusive	Mutually Exclusive	Sequential
DS Hierarchy	Seq(MutEx(DS1,DS2),DS3)		
Descriptions	Ductile fracture of the groove weld flange splice. Damage in field is either obscured or deemed to not warrant repair. No repair conducted.	Ductile fracture of the groove weld flange splice.	DS1 followed by complete failure of the web splice plate and dislocation of the two column segments on either side of the splice.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	0.95	0.05	1.00		
Fragility Parameters					
Median Demand, θ :	0.02	0.02	0.05		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	0.4	0.4	0.4		
Total Dispersion, β :	0.4	0.4	0.4		

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Superior
Data Relevance Superior
Documentation Quality Superior
Rationality Superior

Consequence Functions
Repair Description
Repair would involve gouging out the material adjacent to the fracture and repairing with a new groove weld. Field condition is deemed to not warrant repair by field observation. This Damage State is Mutually Exclusive with DS2. See fragility DS1 and DS2 probabilities.
Repair would involve gouging out the material adjacent to the fracture and repairing with a new groove weld.
Repair may not be practically feasible, but would require either realignment or replacement of adjacent column segments and rewelding of splice.

Long Lead Time (Yes / No) NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	0.00E+00	0.00E+00	0.00E+00	6.37E+03	1.01E+04	1.42E+04	8.37E+03	1.33E+04	1.73E+04						
Best fit mean:	0.00E+00			1.02E+04			1.30E+04								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	0.00E+00 0.00E+00			1.32E+04 8.11E+03			1.60E+04 1.13E+04								
CV or beta (Min Qty, Max Qty)	0.25 0.25			0.30 0.30			0.27 0.27								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	0.00E+00	0.00E+00	0.00E+00	4.68E+00	7.46E+00	1.05E+01	6.15E+00	9.81E+00	1.27E+01						
Best fit mean:	0.00E+00			7.53E+00			9.57E+00								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	0.00E+00 0.00E+00			9.69E+00 5.96E+00			1.18E+01 8.34E+00								
CV or beta (Min Qty, Max Qty)	0.35 0.35			0.39 0.39			0.37 0.37								
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable								
Casualty-affected Planar Area (sf) per Normative Unit:	0%			0%			0%								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			2% 0.50								

Comments: from weld root area.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Greg Deierlein
Revisions: 2015-07-28 revise DS1 and DS2 description and repair to align with FEMA P-38 BD-3.8.3 Page 23. 2016-06-27 Revise DS1 to be MutEx zero cost version of itself.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1031.021c
NISTIR Name Welded column splices, Column W > 300 plf
Description Costing is on a per connection basis. Costing does not include fireproofing removal or reapplication cost.

Line 7

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Mutually Exclusive		Mutually Exclusive		Sequential
DS Hierarchy	Seq(MutEx(DS1,DS2),DS3)				
Descriptions	Ductile fracture of the groove weld flange splice. Damage in field is either obscured or deemed to not warrant repair. No repair conducted.		Ductile fracture of the groove weld flange splice.		DS1 followed by complete failure of the web splice plate and dislocation of the two column segments on either side of the splice.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	0.95	0.05	1.00		
Fragility Parameters					
Median Demand, θ :	0.02	0.02	0.05		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	0.4	0.4	0.4		
Total Dispersion, β :	0.4	0.4	0.4		

Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Superior				
Data Relevance	Superior				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Repair would involve gouging out the material adjacent to the fracture and repairing with a new groove weld. Field condition is deemed to not warrant repair by field observation. This Damage State is Mutually Exclusive with DS2. See fragility DS1 and DS2 probabilities.				
	Repair would involve gouging out the material adjacent to the fracture and repairing with a new groove weld.				
	Repair may not be practically feasible, but would require either realignment or replacement of adjacent column segments and rewelding of splice.				

Long Lead Time (Yes / No)	NO			NO			NO								
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	0.00E+00	0.00E+00	0.00E+00	7.57E+03	1.13E+04	1.54E+04	9.57E+03	1.63E+04	1.85E+04						
Best fit mean:	0.00E+00			1.14E+04			1.48E+04								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	0.00E+00 0.00E+00			1.47E+04 9.07E+03			1.96E+04 1.39E+04								
CV or beta (Min Qty, Max Qty)	0.25 0.25			0.27 0.27			0.24 0.24								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	0.00E+00	0.00E+00	0.00E+00	5.01E+00	7.50E+00	1.02E+01	6.33E+00	1.08E+01	1.23E+01						
Best fit mean:	0.00E+00			7.57E+00			9.80E+00								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	0.00E+00 0.00E+00			9.76E+00 6.00E+00			1.30E+01 9.19E+00								
CV or beta (Min Qty, Max Qty)	0.35 0.35			0.37 0.37			0.34 0.34								
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable								
Casualty-affected Planar Area (sf) per Normative Unit:															
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			2% 0.50								

Comments: from weld root area.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Greg Deierlein
Revisions: 2015-07-28 revise DS1 and DS2 description and repair to align with FEMA P-38 BD-3.8.3 Page 23. 2016-06-27 Revise DS1 to be MutEx zero cost version of itself.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.001a

NISTIR Name

Special Concentric Braced Frame w WF braces, balanced design criteria, Chevron Brace, Brace w < 40 PLF

Description

Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 8

Construction Quality: Not Specified

Seismic Installation Conditions: Not Specified

Fragility Unit of Measure: EA 1

Demand Parameter (unit): Story Drift Ratio Unit less

Number of Damage States: 4

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1,DS2,DS3,DS4)

Descriptions

Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.

Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.

Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.

Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Illustrations

none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.001a-DS4-1.JPG	
1.00	1.00	1.00	1.00	

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.51E+04	3.64E+04	4.10E+04	1.74E+04	3.94E+04	4.52E+04	1.88E+04	4.11E+04	4.76E+04	1.88E+04	4.11E+04	4.76E+04			
Best fit mean:	3.08E+04			3.40E+04			3.58E+04			3.58E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.73E+04			4.72E+04			4.93E+04			4.93E+04			3.49E+04		
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.32 0.32			0.31 0.31			0.31 0.31					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.97E+00	2.41E+01	2.71E+01	1.15E+01	2.60E+01	2.99E+01	1.24E+01	2.72E+01	3.15E+01	1.24E+01	2.72E+01	3.15E+01			
Best fit mean:	2.04E+01			2.25E+01			2.37E+01			2.37E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	3.13E+01			3.13E+01			3.26E+01			3.26E+01			2.31E+01		
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.41 0.41			0.40 0.40			0.40 0.40			0.40 0.40		
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard: Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			60% 0.50			40% 0.50			20% 0.50					

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1033.001b

Special Concentric Braced Frame w WF braces, balanced design criteria, Chevron Brace, Brace 41 PLF < w < 99 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 9

Construction Quality: Not Specified
Seismic Installation Conditions: Not Specified

Fragility Unit of Measure: EA 1
Demand Parameter (unit): Story Drift Ratio Unit less

Quantity Rounding Round Qty? YES
Allow sum by floor or building? NO
Demand Location (floor above?) No

Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.	

Illustrations



Damage State Probability:	1.00	1.00	1.00	1.00	
Fragility Parameters					
Median Demand, θ :	0.0035	0.0058	0.0142	0.0283	
Data dispersion, β_d :	0.38	0.60	0.45	0.05	
Uncertainty, β_u :	0.25	0.25	0.25	0.25	
Total Dispersion, β :	0.45	0.65	0.5	0.25	
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Superior				
Data Relevance	Superior				
Documentation Quality	Average				
Rationality	Superior				
Consequence Functions					
Repair Description	Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.	Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.	Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed	Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed	

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.51E+04	3.64E+04	4.10E+04	2.32E+04	4.65E+04	5.52E+04	2.60E+04	5.00E+04	6.01E+04	2.60E+04	5.00E+04	6.01E+04			
Best fit mean:	3.08E+04			4.16E+04			4.53E+04			4.53E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.73E+04			5.58E+04			6.00E+04			6.00E+04			4.25E+04		
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.30 0.30			0.29 0.29			0.29 0.29					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.97E+00	2.41E+01	2.71E+01	1.53E+01	3.08E+01	3.65E+01	1.72E+01	3.31E+01	3.97E+01	1.72E+01	3.31E+01	3.97E+01			
Best fit mean:	2.04E+01			2.75E+01			3.00E+01			3.00E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	3.13E+01			3.69E+01			3.97E+01			3.97E+01			2.81E+01		
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.39 0.39			0.39 0.39			0.39 0.39					
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			60% 0.50			40% 0.50			20% 0.50					

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1033.001c

Special Concentric Braced Frame w WF braces, balanced design criteria, Chevron Brace, Brace w > 100 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 10

Construction Quality: Not Specified
Seismic Installation Conditions: Not Specified

Fragility Unit of Measure: EA 1
Demand Parameter (unit): Story Drift Ratio Unit less

Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Illustrations

				
none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.001a-DS4-1.JPG	
1.00	1.00	1.00	1.00	

Damage State Probability:	1.00	1.00	1.00	1.00	
Fragility Parameters					
Median Demand, θ :	0.0035	0.0058	0.0142	0.0283	
Data dispersion, β_d :	0.38	0.60	0.45	0.05	
Uncertainty, β_u :	0.25	0.25	0.25	0.25	
Total Dispersion, β :	0.45	0.65	0.5	0.25	
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Superior				
Data Relevance	Superior				
Documentation Quality	Average				
Rationality	Superior				
Consequence Functions					
Repair Description	Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.	Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.	Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed	Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed	

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.51E+04	3.64E+04	4.10E+04	3.03E+04	5.54E+04	6.76E+04	3.47E+04	6.09E+04	7.53E+04	3.47E+04	6.09E+04	7.53E+04			
Best fit mean:	3.08E+04			5.11E+04			5.69E+04			5.69E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.73E+04			2.91E+04			6.65E+04			4.71E+04			7.31E+04 5.18E+04		
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.28 0.28			0.28 0.28			0.28 0.28					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.97E+00	2.41E+01	2.71E+01	2.00E+01	3.67E+01	4.47E+01	2.29E+01	4.03E+01	4.98E+01	2.29E+01	4.03E+01	4.98E+01			
Best fit mean:	2.04E+01			3.38E+01			3.77E+01			3.77E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	3.13E+01			1.93E+01			4.40E+01			3.12E+01			4.84E+01 3.43E+01		
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.38 0.38			0.37 0.37			0.37 0.37					
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard: Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			60% 0.50			40% 0.50			20% 0.50					

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.002a

NISTIR Name

Special Concentric Braced Frame w WF braces, balanced design criteria, Single Diagonal Brace, Brace w < 40 PLF

Description

Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 11

Construction Quality: Not Specified

Seismic Installation Conditions: Not Specified

Fragility Unit of Measure: EA 1

Demand Parameter (unit): Story Drift Ratio Unit less

Number of Damage States: 4

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Sequential

Seq(DS1,DS2,DS3,DS4)

Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.

Sequential

Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.

Sequential

Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.

Sequential

Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Illustrations

none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.001a-DS4-1.JPG	
1.00	1.00	1.00	1.00	

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Long Lead Time (Yes / No)

NO

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.45E+04	3.56E+04	3.99E+04	1.71E+04	3.89E+04	4.46E+04	1.73E+04	3.92E+04	4.49E+04	1.73E+04	3.92E+04	4.49E+04			
Best fit mean:	3.00E+04			3.35E+04			3.38E+04			3.38E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.63E+04 0.33 2.85E+04 0.33			4.67E+04 0.32 3.31E+04 0.32			4.70E+04 0.32 3.33E+04 0.32			4.70E+04 0.32 3.33E+04 0.32					
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.57E+00	2.36E+01	2.64E+01	1.13E+01	2.58E+01	2.95E+01	1.14E+01	2.59E+01	2.97E+01	1.14E+01	2.59E+01	2.97E+01			
Best fit mean:	1.98E+01			2.22E+01			2.23E+01			2.23E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	3.06E+01 0.41 1.89E+01 0.41			3.09E+01 0.41 2.19E+01 0.41			3.11E+01 0.41 2.20E+01 0.41			3.11E+01 0.41 2.20E+01 0.41					
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Casualty-affected Planar Area (sf) per Normative Unit:															
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			60% 0.50			40% 0.50			20% 0.50					

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1033.002b

Special Concentric Braced Frame w WF braces, balanced design criteria, Single Diagonal Brace, 41 PLF < w < 99 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 12

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Illustrations

				
none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.001a-DS4-1.JPG	
1.00	1.00	1.00	1.00	

Damage State Probability:	1.00	1.00	1.00	1.00	
Fragility Parameters					
Median Demand, θ :	0.0035	0.0058	0.0142	0.0283	
Data dispersion, β_d :	0.38	0.60	0.45	0.05	
Uncertainty, β_u :	0.25	0.25	0.25	0.25	
Total Dispersion, β :	0.45	0.65	0.5	0.25	
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Superior				
Data Relevance	Superior				
Documentation Quality	Average				
Rationality	Superior				
Consequence Functions					
Repair Description	<div>Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.</div> <div>Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.</div> <div>Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed</div> <div>Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed</div>				

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.45E+04	3.56E+04	3.99E+04	2.03E+04	4.29E+04	5.00E+04	2.27E+04	4.59E+04	5.42E+04	2.27E+04	4.59E+04	5.42E+04			
Best fit mean:	3.00E+04			3.77E+04			4.09E+04			4.09E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.63E+04 0.33 2.85E+04 0.33			5.14E+04 0.31 3.64E+04 0.31			5.50E+04 0.30 3.90E+04 0.30			5.50E+04 0.30 3.90E+04 0.30					
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.57E+00	2.36E+01	2.64E+01	1.34E+01	2.84E+01	3.31E+01	1.50E+01	3.04E+01	3.58E+01	1.50E+01	3.04E+01	3.58E+01			
Best fit mean:	1.98E+01			2.49E+01			2.71E+01			2.71E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	3.06E+01 0.41 1.89E+01 0.41			3.40E+01 0.40 2.41E+01 0.40			3.64E+01 0.39 2.58E+01 0.39			3.64E+01 0.39 2.58E+01 0.39					
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			60% 0.50			40% 0.50			20% 0.50					

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1033.002c

Special Concentric Braced Frame w WF braces, balanced design criteria, Single Diagonal Brace, Brace w > 100 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 13

Construction Quality: Not Specified
Seismic Installation Conditions: Not Specified

Fragility Unit of Measure: EA 1
Demand Parameter (unit): Story Drift Ratio Unit less

Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Illustrations

				
none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.001a-DS4-1.JPG	
1.00	1.00	1.00	1.00	

Damage State Probability:	1.00	1.00	1.00	1.00	
Fragility Parameters					
Median Demand, θ :	0.0035	0.0058	0.0142	0.0283	
Data dispersion, β_d :	0.38	0.60	0.45	0.05	
Uncertainty, β_u :	0.25	0.25	0.25	0.25	
Total Dispersion, β :	0.45	0.65	0.5	0.25	

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Superior
Data Relevance Superior
Documentation Quality Average
Rationality Superior

Consequence Functions

Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Cost by Damage State:	1.45E+04	3.56E+04	3.99E+04	2.47E+04	4.84E+04	5.77E+04	2.91E+04	5.39E+04	6.54E+04	2.91E+04	5.39E+04	6.54E+04			
Best fit mean:	3.00E+04			4.36E+04			4.94E+04			4.94E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.63E+04 0.33 0.33			5.80E+04 0.30 0.30			6.46E+04 0.29 0.29			6.46E+04 0.29 0.29					
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Time by Damage State:	9.57E+00	2.36E+01	2.64E+01	1.63E+01	3.20E+01	3.82E+01	1.92E+01	3.57E+01	4.33E+01	1.92E+01	3.57E+01	4.33E+01			
Best fit mean:	1.98E+01			2.88E+01			3.27E+01			3.27E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	3.06E+01 0.41 0.41			3.84E+01 0.39 0.39			4.28E+01 0.38 0.38			4.28E+01 0.38 0.38					
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			60% 0.50			40% 0.50			20% 0.50					

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1033.003a

Special Concentric Braced Frame w WF braces, balanced design criteria, X Brace, Brace w < 40 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 14

Construction Quality: Not Specified
Seismic Installation Conditions: Not Specified

Fragility Unit of Measure: EA 1

Demand Parameter (unit): Story Drift Ratio Unit less

Number of Damage States: 4

Damage State:	DS1	DS2	DS3	DS4
Type of Damage State:	Sequential	Sequential	Sequential	Sequential
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)			
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00	1.00	1.00
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Fragility Parameters

Median Demand, θ :	0.0035	0.0058	0.0142	0.0283
Data dispersion, β_d :	0.38	0.60	0.45	0.05
Uncertainty, β_u :	0.25	0.25	0.25	0.25
Total Dispersion, β :	0.45	0.65	0.5	0.25

Correlation (Yes / No) NO

Directionality (Yes / No) YES

Quality Ratings

Data Quality Superior
Data Relevance Superior
Documentation Quality Average
Rationality Superior

Consequence Functions

Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.58E+04	3.72E+04	4.22E+04	2.02E+04	4.28E+04	5.00E+04	2.10E+04	4.38E+04	5.14E+04	2.10E+04	4.38E+04	5.14E+04			
Best fit mean:	3.17E+04			3.76E+04			3.87E+04			3.87E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.84E+04 2.98E+04			5.14E+04 3.64E+04			5.26E+04 3.72E+04			5.26E+04 3.72E+04					
CV or beta (Min Qty, Max Qty)	0.32 0.32			0.31 0.31			0.31 0.31			0.31 0.31					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.04E+01	2.46E+01	2.79E+01	1.33E+01	2.83E+01	3.31E+01	1.39E+01	2.90E+01	3.40E+01	1.39E+01	2.90E+01	3.40E+01			
Best fit mean:	2.10E+01			2.49E+01			2.56E+01			2.56E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	3.20E+01 1.97E+01			3.40E+01 2.41E+01			3.48E+01 2.47E+01			3.48E+01 2.47E+01					
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.40 0.40			0.40 0.40			0.40 0.40					
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			60% 0.50			40% 0.50			20% 0.50					

Comments: None

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1033.003b

Special Concentric Braced Frame w WF braces, balanced design criteria, X Brace, 41 PLF < w < 99 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 15

Construction Quality: Not Specified
Seismic Installation Conditions: Not Specified

Fragility Unit of Measure: EA 1
Demand Parameter (unit): Story Drift Ratio Unit less

Number of Damage States: 4
Damage State: DS1 DS2 DS3 DS4
Type of Damage State: Sequential Sequential Sequential Sequential
DS Hierarchy Seq(DS1,DS2,DS3,DS4)

Descriptions
Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.
Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.
Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.
Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.

Quantity Rounding Round Qty? YES
Allow sum by floor or building? NO
Demand Location (floor above?) No

Illustrations



Damage State Probability:	1.00	1.00	1.00	1.00
Fragility Parameters				
Median Demand, θ :	0.0035	0.0058	0.0142	0.0283
Data dispersion, β_d :	0.38	0.60	0.45	0.05
Uncertainty, β_u :	0.25	0.25	0.25	0.25
Total Dispersion, β :	0.45	0.65	0.5	0.25

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Superior
Data Relevance Superior
Documentation Quality Average
Rationality Superior

Consequence Functions
Repair Description
Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.
Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.
Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.
Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.58E+04	3.72E+04	4.22E+04	2.84E+04	5.30E+04	6.42E+04	3.08E+04	5.60E+04	6.84E+04	3.08E+04	5.60E+04	6.84E+04			
Best fit mean:	3.17E+04			4.85E+04			5.17E+04			5.17E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.84E+04			2.98E+04			6.36E+04			4.50E+04			6.72E+04 4.76E+04		
CV or beta (Min Qty, Max Qty)	0.32 0.32			0.29 0.29			0.28 0.28			0.28 0.28					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.04E+01	2.46E+01	2.79E+01	1.88E+01	3.51E+01	4.25E+01	2.04E+01	3.70E+01	4.52E+01	2.04E+01	3.70E+01	4.52E+01			
Best fit mean:	2.10E+01			3.21E+01			3.42E+01			3.42E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	3.20E+01			1.97E+01			4.21E+01			2.98E+01			4.45E+01 3.15E+01		
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.38 0.38			0.38 0.38			0.38 0.38					
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard: Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			60% 0.50			40% 0.50			20% 0.50					

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1033.003c
NISTIR Name Special Concentric Braced Frame w WF braces, balanced design criteria, X Brace, Brace w > 100 PLF
Description Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 16

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.001a-DS4-1.JPG	
1.00	1.00	1.00	1.00	

Damage State Probability:	1.00	1.00	1.00	1.00	
Fragility Parameters					
Median Demand, θ :	0.0035	0.0058	0.0142	0.0283	
Data dispersion, β_d :	0.38	0.60	0.45	0.05	
Uncertainty, β_u :	0.25	0.25	0.25	0.25	
Total Dispersion, β :	0.45	0.65	0.5	0.25	
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Superior				
Data Relevance	Superior				
Documentation Quality	Average				
Rationality	Superior				
Consequence Functions					
Repair Description	<p>Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.</p> <p>Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.</p> <p>Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed</p> <p>Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed</p>				

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.58E+04	3.72E+04	4.22E+04	3.84E+04	6.55E+04	8.17E+04	4.28E+04	7.10E+04	8.94E+04	4.28E+04	7.10E+04	8.94E+04			
Best fit mean:	3.17E+04			6.18E+04			6.77E+04			6.77E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.84E+04			7.86E+04			8.52E+04			6.03E+04			8.52E+04 6.03E+04		
CV or beta (Min Qty, Max Qty)	0.32 0.32			0.27 0.27			0.27 0.27			0.27 0.27					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.04E+01	2.46E+01	2.79E+01	2.54E+01	4.33E+01	5.40E+01	2.83E+01	4.70E+01	5.91E+01	2.83E+01	4.70E+01	5.91E+01			
Best fit mean:	2.10E+01			4.09E+01			4.48E+01			4.48E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	3.20E+01			5.20E+01			5.64E+01			3.99E+01			5.64E+01 3.99E+01		
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.37 0.37			0.37 0.37			0.37 0.37					
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			60% 0.50			40% 0.50			20% 0.50					

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.011a

NISTIR Name

Special Concentric Braced Frame w HSS braces, balanced design criteria, Chevron Brace, Brace w < 40 PLF

Description

Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 17

Construction Quality: Not Specified

Seismic Installation Conditions: Not Specified

Fragility Unit of Measure: EA 1

Demand Parameter (unit): Story Drift Ratio Unit less

Number of Damage States: 4

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Sequential

Seq(DS1,DS2,DS3,DS4)

Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.

Sequential

Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.

Sequential

Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.

Sequential

Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Illustrations

				
none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.011a-DS3-2.JPG	
1.00	1.00	1.00	1.00	

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.45E+04	3.56E+04	3.99E+04	1.80E+04	4.00E+04	4.60E+04	1.94E+04	4.17E+04	4.84E+04	1.94E+04	4.17E+04	4.84E+04			
Best fit mean:	3.00E+04			3.46E+04			3.65E+04			3.65E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.63E+04			4.80E+04			5.01E+04			5.01E+04					
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.32 0.32			0.31 0.31			0.31 0.31					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.57E+00	2.36E+01	2.64E+01	1.19E+01	2.65E+01	3.04E+01	1.28E+01	2.76E+01	3.20E+01	1.28E+01	2.76E+01	3.20E+01			
Best fit mean:	1.98E+01			2.29E+01			2.41E+01			2.41E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	3.07E+01			3.18E+01			3.31E+01			3.31E+01					
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.40 0.40			0.40 0.40			0.40 0.40					
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard: Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	YES			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	60% 0.50			40% 0.50			20% 0.50			20% 0.50					

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1033.011b
NISTIR Name Special Concentric Braced Frame w HSS braces, balanced design criteria, Chevron Brace, Brace 41 PLF < w < 99 PLF
Description Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 18

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.011a-DS3-2.JPG	
1.00	1.00	1.00	1.00	

Damage State Probability:	1.00	1.00	1.00	1.00	
Fragility Parameters					
Median Demand, θ :	0.0035	0.0092	0.0167	0.0223	
Data dispersion, β_d :	0.38	0.30	0.1	0.1	
Uncertainty, β_u :	0.25	0.1	0.1	0.1	
Total Dispersion, β :	0.45	0.3	0.15	0.15	

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Superior
Data Relevance Superior
Documentation Quality Superior
Rationality Superior
Consequence Functions

Repair Description
Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.
Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.
Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed
Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No) NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.45E+04	3.56E+04	3.99E+04	2.51E+04	4.89E+04	5.85E+04	2.79E+04	5.24E+04	6.34E+04	2.79E+04	5.24E+04	6.34E+04			
Best fit mean:	3.00E+04			4.41E+04			4.79E+04			4.79E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.63E+04 0.33 2.85E+04 0.33			5.87E+04 0.30 4.16E+04 0.30			6.29E+04 0.29 4.46E+04 0.29			6.29E+04 0.29 4.46E+04 0.29					
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.57E+00	2.36E+01	2.64E+01	1.66E+01	3.24E+01	3.87E+01	1.84E+01	3.47E+01	4.19E+01	1.84E+01	3.47E+01	4.19E+01			
Best fit mean:	1.98E+01			2.92E+01			3.17E+01			3.17E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	3.07E+01 0.41 1.89E+01 0.41			3.89E+01 0.39 2.75E+01 0.39			4.16E+01 0.38 2.95E+01 0.38			4.16E+01 0.38 2.95E+01 0.38					
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	YES			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	60% 0.50			40% 0.50			20% 0.50			20% 0.50					

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.011c

NISTIR Name

Special Concentric Braced Frame w HSS braces, balanced design criteria, Chevron Brace, Brace w > 100 PLF

Description

Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 19

Construction Quality: Not Specified

Seismic Installation Conditions: Not Specified

Fragility Unit of Measure: EA 1

Demand Parameter (unit): Story Drift Ratio Unit less

Number of Damage States: 4

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Sequential

Seq(DS1,DS2,DS3,DS4)

Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.

Sequential

Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.

Sequential

Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.

Sequential

Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Illustrations

				
none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.011a-DS3-2.JPG	
1.00	1.00	1.00	1.00	

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.45E+04	3.56E+04	3.99E+04	3.40E+04	6.01E+04	7.41E+04	3.80E+04	6.51E+04	8.11E+04	3.80E+04	6.51E+04	8.11E+04			
Best fit mean:	3.00E+04			5.60E+04			6.14E+04			6.14E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.28E+04 2.85E+04			7.21E+04 4.81E+04			7.81E+04 5.21E+04			7.81E+04 5.21E+04					
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.28 0.28			0.27 0.27			0.27 0.27					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.57E+00	2.36E+01	2.64E+01	2.25E+01	3.98E+01	4.90E+01	2.51E+01	4.31E+01	5.36E+01	2.51E+01	4.31E+01	5.36E+01			
Best fit mean:	1.98E+01			3.71E+01			4.06E+01			4.06E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.83E+01 1.89E+01			4.77E+01 3.18E+01			5.17E+01 3.45E+01			5.17E+01 3.45E+01					
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.37 0.37			0.37 0.37			0.37 0.37					
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	YES			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	60% 0.50			40% 0.50			20% 0.50			20% 0.50					

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1033.012a

Special Concentric Braced Frame w HSS braces, balanced design criteria, Single Diagonal Brace, Brace w < 40 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 20

Construction Quality: Not Specified
Seismic Installation Conditions: Not Specified

Fragility Unit of Measure:	EA 1
Demand Parameter (unit):	Story Drift Ratio Unit less
Number of Damage States:	4

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.	

Illustrations

					
	none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.011a-DS3-2.JPG	
Damage State Probability:	1.00	1.00	1.00	1.00	

Fragility Parameters					
Median Demand, θ :	0.0035	0.0092	0.0167	0.0223	
Data dispersion, β_d :	0.38	0.30	0.1	0.1	
Uncertainty, β_u :	0.25	0.1	0.1	0.1	
Total Dispersion, β :	0.45	0.3	0.15	0.15	

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Superior
Data Relevance Superior
Documentation Quality Superior
Rationality Superior
Consequence Functions

Repair Description
Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.
Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.
Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed
Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.39E+04	3.49E+04	3.88E+04	1.69E+04	3.86E+04	4.41E+04	1.77E+04	3.96E+04	4.55E+04	1.77E+04	3.96E+04	4.55E+04			
Best fit mean:	2.92E+04			3.32E+04			3.43E+04			3.43E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.18E+04			4.64E+04			4.76E+04			4.76E+04			3.17E+04		
CV or beta (Min Qty, Max Qty)	0.33			0.32			0.32			0.32			0.32		
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.17E+00	2.31E+01	2.57E+01	1.12E+01	2.56E+01	2.92E+01	1.17E+01	2.62E+01	3.01E+01	1.17E+01	2.62E+01	3.01E+01			
Best fit mean:	1.93E+01			2.20E+01			2.27E+01			2.27E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.77E+01			3.07E+01			3.15E+01			3.15E+01			2.10E+01		
CV or beta (Min Qty, Max Qty)	0.42			0.41			0.40			0.40			0.40		
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	YES			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	60% 0.50			40% 0.50			20% 0.50			20% 0.50					

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification
NISTIR Name
Description

B1033.012b
Special Concentric Braced Frame w HSS braces, balanced design criteria, Single Diagonal Brace, Brace 41 PLF < w < 99 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 21

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Illustrations

				
none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.011a-DS3-2.JPG	

Damage State Probability:	1.00	1.00	1.00	1.00
Fragility Parameters				
Median Demand, θ :	0.0035	0.0092	0.0167	0.0223
Data dispersion, β_d :	0.38	0.30	0.1	0.1
Uncertainty, β_u :	0.25	0.1	0.1	0.1
Total Dispersion, β :	0.45	0.3	0.15	0.15
Correlation (Yes / No)	NO			
Directionality (Yes / No)	YES			
Quality Ratings				
Data Quality	Superior			
Data Relevance	Superior			
Documentation Quality	Superior			
Rationality	Superior			
Consequence Functions				
Repair Description	Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.	Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.	Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed	Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.39E+04	3.49E+04	3.88E+04	2.12E+04	4.40E+04	5.17E+04	2.40E+04	4.75E+04	5.66E+04	2.40E+04	4.75E+04	5.66E+04			
Best fit mean:	2.92E+04			3.89E+04			4.27E+04			4.27E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.18E+04 0.33 2.79E+04 0.33			5.28E+04 0.31 3.52E+04 0.31			5.70E+04 0.30 3.80E+04 0.30			5.70E+04 0.30 3.80E+04 0.30					
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.17E+00	2.31E+01	2.57E+01	1.40E+01	2.91E+01	3.42E+01	1.59E+01	3.14E+01	3.74E+01	1.59E+01	3.14E+01	3.74E+01			
Best fit mean:	1.93E+01			2.58E+01			2.82E+01			2.82E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.77E+01 0.42 1.85E+01 0.42			3.50E+01 0.39 2.33E+01 0.39			3.77E+01 0.39 2.52E+01 0.39			3.77E+01 0.39 2.52E+01 0.39					
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	YES			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	60% 0.50			40% 0.50			20% 0.50			20% 0.50					

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1033.012c
NISTIR Name Special Concentric Braced Frame w HSS braces, balanced design criteria, Single Diagonal Brace, Brace w > 100 PLF
Description Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 22

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.011a-DS3-2.JPG	
1.00	1.00	1.00	1.00	

Damage State Probability:	1.00	1.00	1.00	1.00	
Fragility Parameters					
Median Demand, θ :	0.0035	0.0092	0.0167	0.0223	
Data dispersion, β_d :	0.38	0.30	0.1	0.1	
Uncertainty, β_u :	0.25	0.1	0.1	0.1	
Total Dispersion, β :	0.45	0.3	0.15	0.15	
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Superior				
Data Relevance	Superior				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.				

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.39E+04	3.49E+04	3.88E+04	2.70E+04	5.12E+04	6.17E+04	3.14E+04	5.67E+04	6.94E+04	3.14E+04	5.67E+04	6.94E+04			
Best fit mean:	2.92E+04			4.68E+04			5.25E+04			5.25E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.18E+04 0.33			6.15E+04 0.29			6.81E+04 0.28			6.81E+04 0.28					
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.29 0.29			0.28 0.28			0.28 0.28					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.17E+00	2.31E+01	2.57E+01	1.78E+01	3.39E+01	4.08E+01	2.08E+01	3.75E+01	4.59E+01	2.08E+01	3.75E+01	4.59E+01			
Best fit mean:	1.93E+01			3.08E+01			3.47E+01			3.47E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.77E+01 0.42			4.07E+01 0.38			4.50E+01 0.38			4.50E+01 0.38					
CV or beta (Min Qty, Max Qty)	0.42 0.42			0.38 0.38			0.38 0.38			0.38 0.38					
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	YES			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	60% 0.50			40% 0.50			20% 0.50			20% 0.50					

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1033.013a
NISTIR Name Special Concentric Braced Frame w HSS braces, balanced design criteria, X Brace, Brace w < 40 PLF
Description Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 23

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Illustrations

				
none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.011a-DS3-2.JPG	
1.00	1.00	1.00	1.00	

Damage State Probability:	1.00	1.00	1.00	1.00	
Fragility Parameters					
Median Demand, θ :	0.0035	0.0092	0.0167	0.0223	
Data dispersion, β_d :	0.38	0.30	0.1	0.1	
Uncertainty, β_u :	0.25	0.1	0.1	0.1	
Total Dispersion, β :	0.45	0.3	0.15	0.15	

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Superior
Data Relevance Superior
Documentation Quality Superior
Rationality Superior
Consequence Functions

Repair Description
Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.
Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.
Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed
Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No) NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.52E+04	3.65E+04	4.11E+04	2.04E+04	4.30E+04	5.02E+04	2.16E+04	4.45E+04	5.23E+04	2.16E+04	4.45E+04	5.23E+04			
Best fit mean:	3.09E+04			3.78E+04			3.94E+04			3.94E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.38E+04 0.33 2.92E+04 0.33			5.16E+04 0.31 3.44E+04 0.31			5.34E+04 0.30 3.56E+04 0.30			5.34E+04 0.30 3.56E+04 0.30					
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.00E+01	2.41E+01	2.72E+01	1.35E+01	2.85E+01	3.32E+01	1.43E+01	2.94E+01	3.46E+01	1.43E+01	2.94E+01	3.46E+01			
Best fit mean:	2.04E+01			2.50E+01			2.61E+01			2.61E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.90E+01 0.41 1.93E+01 0.41			3.41E+01 0.40 2.28E+01 0.40			3.53E+01 0.39 2.36E+01 0.39			3.53E+01 0.39 2.36E+01 0.39					
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Casualty-affected Planar Area (sf) per Normative Unit:															
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	YES			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	60% 0.50			40% 0.50			20% 0.50			20% 0.50					

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.013b

NISTIR Name

Special Concentric Braced Frame w HSS braces, balanced design criteria, X Brace, Brace 41 PLF < w < 99 PLF

Description

Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 24

Construction Quality: Not Specified

Seismic Installation Conditions: Not Specified

Fragility Unit of Measure: EA 1

Demand Parameter (unit): Story Drift Ratio Unit less

Number of Damage States: 4

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Sequential

Seq(DS1,DS2,DS3,DS4)

Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.

Sequential

Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.

Sequential

Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.

Sequential

Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Illustrations

				
none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.011a-DS3-2.JPG	
1.00	1.00	1.00	1.00	

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.52E+04	3.65E+04	4.11E+04	3.04E+04	5.55E+04	6.77E+04	3.32E+04	5.90E+04	7.26E+04	3.32E+04	5.90E+04	7.26E+04			
Best fit mean:	3.09E+04			5.12E+04			5.49E+04			5.49E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.38E+04			2.92E+04			6.65E+04			4.44E+04			7.07E+04		
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.28 0.28			0.28 0.28			0.28 0.28			0.28 0.28		
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.00E+01	2.41E+01	2.72E+01	2.01E+01	3.67E+01	4.48E+01	2.19E+01	3.90E+01	4.80E+01	2.19E+01	3.90E+01	4.80E+01			
Best fit mean:	2.04E+01			3.39E+01			3.63E+01			3.63E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.90E+01			1.93E+01			4.40E+01			2.94E+01			4.68E+01		
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.38 0.38			0.38 0.38			0.38 0.38			0.38 0.38		
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard: Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	YES			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	60% 0.50			40% 0.50			20% 0.50			20% 0.50					

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1033.013c

Special Concentric Braced Frame w HSS braces, balanced design criteria, X Brace, Brace w > 100 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 25

Construction Quality: Not Specified
Seismic Installation Conditions: Not Specified

Fragility Unit of Measure:	EA 1
Demand Parameter (unit):	Story Drift Ratio Unit less
Number of Damage States:	4

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.	

Illustrations

				
none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.011a-DS3-2.JPG	
1.00	1.00	1.00	1.00	

Damage State Probability:	1.00	1.00	1.00	1.00	
Fragility Parameters					
Median Demand, θ :	0.0035	0.0092	0.0167	0.0223	
Data dispersion, β_d :	0.38	0.30	0.1	0.1	
Uncertainty, β_u :	0.25	0.1	0.1	0.1	
Total Dispersion, β :	0.45	0.3	0.15	0.15	

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Superior
Data Relevance Superior
Documentation Quality Superior
Rationality Superior
Consequence Functions

Repair Description
Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.
Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.
Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed
Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀			
Repair Cost by Damage State:	1.52E+04	3.65E+04	4.11E+04	4.25E+04	7.07E+04	8.90E+04	4.69E+04	7.62E+04	9.67E+04	4.69E+04	7.62E+04	9.67E+04						
Best fit mean:	3.09E+04			6.74E+04			7.32E+04			7.32E+04								
Best Fit Distribution:	Normal			Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	4.38E+04			2.92E+04			8.48E+04			5.65E+04			9.14E+04			6.09E+04		
CV or beta (Min Qty, Max Qty)	0.33			0.33			0.27			0.27			0.27			0.27		
Quantity Unit:	Each			Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀			
Repair Time by Damage State:	1.00E+01	2.41E+01	2.72E+01	2.81E+01	4.68E+01	5.89E+01	3.10E+01	5.04E+01	6.40E+01	3.10E+01	5.04E+01	6.40E+01						
Best fit mean:	2.04E+01			4.46E+01			4.85E+01			4.85E+01								
Best Fit Distribution:	Normal			Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	2.90E+01			1.93E+01			5.61E+01			3.74E+01			6.05E+01			4.03E+01		
CV or beta (Min Qty, Max Qty)	0.41			0.41			0.37			0.37			0.36			0.36		
Quantity Unit:	Each			Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable			Not Applicable								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	YES			YES			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	60% 0.50			40% 0.50			20% 0.50			20% 0.50								

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1033.021a

Special Concentric Braced Frame w HSS braces, tapered gusset plates & design to AISC minimum standard, Chevron Brace, Brace w < 40 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 26

Construction Quality: Not Specified
Seismic Installation Conditions: Not Specified

Fragility Unit of Measure: EA 1

Demand Parameter (unit): Story Drift Ratio Unit less

Number of Damage States: 4

Damage State:	DS1	DS2	DS3	DS4
Type of Damage State:	Sequential	Sequential	Sequential	Sequential
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)			
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 time brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.

DS Hierarchy

Descriptions

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Illustrations



Damage State Probability:	DS1	DS2	DS3	DS4
	1.00	1.00	1.00	1.00

Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.

Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.	DS1	DS2	DS3	DS4
Median Demand, θ :	0.0037	0.0075	0.0145	0.0199
Data dispersion, β_d :	0.26	0.25	0.2	0.35
Uncertainty, β_u :	0.1	0.1	0.1	0.1
Total Dispersion, β :	0.3	0.25	0.25	0.35

Median Demand, θ :	DS1	DS2	DS3	DS4
	0.0037	0.0075	0.0145	0.0199

Data dispersion, β_d :	DS1	DS2	DS3	DS4
	0.26	0.25	0.2	0.35

Uncertainty, β_u :	DS1	DS2	DS3	DS4
	0.1	0.1	0.1	0.1

Total Dispersion, β :	DS1	DS2	DS3	DS4
	0.3	0.25	0.25	0.35

Correlation (Yes / No) NO

Directionality (Yes / No) YES

Quality Ratings

Data Quality Superior

Data Relevance Superior

Documentation Quality Average

Rationality Superior

Consequence Functions

Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. Tapered gusset plates typically sustain greater damage and there is a higher probability that replacement will be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Long Lead Time (Yes / No)

NO

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.49E+04	3.61E+04	4.05E+04	1.84E+04	4.05E+04	4.66E+04	1.98E+04	4.22E+04	4.90E+04	1.98E+04	4.22E+04	4.90E+04			

Best fit mean:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
	5.00	20.00		5.00	20.00		5.00	20.00		5.00	20.00				

Best Fit Distribution:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
	Normal			Normal			Normal			Normal					

Quantity Plateau (Min Qty, Max Qty)	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
	5.00	20.00		5.00	20.00		5.00	20.00		5.00	20.00				

Average Repair Cost (Min Qty, Max Qty)	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
	4.33E+04	2.89E+04		4.86E+04	3.24E+04		5.06E+04	3.37E+04		5.06E+04	3.37E+04				

CV or beta (Min Qty, Max Qty)	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
	0.33	0.33		0.31	0.31		0.31	0.31		0.31	0.31				

Quantity Unit:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
	Each			Each			Each			Each					

Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.83E+00	2.39E+01	2.68E+01	1.22E+01	2.68E+01	3.08E+01	1.31E+01	2.79E+01	3.24E+01	1.31E+01	2.79E+01	3.24E+01			

Best fit mean:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
	2.02E+01			2.32E+01			2.45E+01			2.45E+01					

Best Fit Distribution:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
	Normal			Normal			Normal			Normal					

Quantity Plateau (Min Qty, Max Qty)	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
	5.00	20.00		5.00	20.00		5.00	20.00		5.00	20.00				

Average Repair Time (Min Qty, Max Qty)	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
	2.87E+01	1.91E+01		3.21E+01	2.14E+01		3.35E+01	2.23E+01		3.35E+01	2.23E+01				

CV or beta (Min Qty, Max Qty)	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
	0.41	0.41		0.40	0.40		0.40	0.40		0.40	0.40				

Quantity Unit:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
	Each			Each			Each			Each					

LifeSafety Hazard:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					

Casualty-affected Planar Area (sf) per Normative Unit:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
	Not Applicable			Not Applicable			Not Applicable			Not Applicable					

Serious Injury (Median, Dispersion)	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
	0%	0.00		0%	0.00		0%	0.00		0%	0.00				

Loss of Life (Median, Dispersion)	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
	0%	0.00		0%	0.00		0%	0.00		0%	0.00				

Post-event Tagging Flag:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
	NO			YES			YES			YES					

Unsafe Placard Trigger (Median, Dispersion)	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
	0%	0.00		60%	0.50		40%	0.50		20%	0.50				

Comments:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
	None														

Date Created:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
	Not Given														

Approved (YES / NO)?	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
	By User														

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1033.021b

Special Concentric Braced Frame w HSS braces, tapered gusset plates & design to AISC minimum standard, Chevron Brace, Brace 41 PLF < w < 99 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 27

Construction Quality: Not Specified
Seismic Installation Conditions: Not Specified

Fragility Unit of Measure:	EA 1
Demand Parameter (unit):	Story Drift Ratio Unit less
Number of Damage States:	4

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 time brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.	

Illustrations

	none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.011a-DS3-2.JPG	
Damage State Probability:	1.00	1.00	1.00	1.00	

Fragility Parameters					
Median Demand, θ :	0.0037	0.0075	0.0145	0.0199	
Data dispersion, β_d :	0.26	0.25	0.2	0.35	
Uncertainty, β_u :	0.1	0.1	0.1	0.1	
Total Dispersion, β :	0.3	0.25	0.25	0.35	

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Superior
Data Relevance Superior
Documentation Quality Average
Rationality Superior

Consequence Functions

Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. Tapered gusset plates typically sustain greater damage and there is a higher probability that replacement will be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Cost by Damage State:	1.49E+04	3.61E+04	4.05E+04	2.58E+04	4.98E+04	5.98E+04	2.86E+04	5.33E+04	6.47E+04	2.86E+04	5.33E+04	6.47E+04			
Best fit mean:	3.05E+04			4.51E+04			4.88E+04			4.88E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.33E+04 0.33 2.89E+04 0.33			5.98E+04 0.29 3.99E+04 0.29			6.40E+04 0.29 4.27E+04 0.29			6.40E+04 0.29 4.27E+04 0.29					
CV or beta (Min Qty, Max Qty)	0.33			0.29			0.29			0.29					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Time by Damage State:	9.83E+00	2.39E+01	2.68E+01	1.70E+01	3.30E+01	3.95E+01	1.89E+01	3.53E+01	4.28E+01	1.89E+01	3.53E+01	4.28E+01			
Best fit mean:	2.02E+01			2.99E+01			3.23E+01			3.23E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.87E+01 0.41 1.91E+01 0.41			3.96E+01 0.39 2.64E+01 0.39			4.23E+01 0.38 2.82E+01 0.38			4.23E+01 0.38 2.82E+01 0.38					
CV or beta (Min Qty, Max Qty)	0.41			0.39			0.38			0.38					
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			60% 0.50			40% 0.50			20% 0.50					

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1033.022a

Special Concentric Braced Frame w HSS braces, tapered gusset plates & design to AISC minimum standard Single Diagonal Brace, Brace w < 40 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 29

Construction Quality: Not Specified
Seismic Installation Conditions: Not Specified

Fragility Unit of Measure: EA 1

Demand Parameter (unit): Story Drift Ratio Unit less

Number of Damage States: 4

Damage State:	DS1	DS2	DS3	DS4
Type of Damage State:	Sequential	Sequential	Sequential	Sequential
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)			
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 time brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.

Quantity Rounding Round Qty? YES
Allow sum by floor or building? NO
Demand Location (floor above?) No

Illustrations



Damage State Probability:	1.00	1.00	1.00	1.00
Fragility Parameters				
Median Demand, θ :	0.0037	0.0075	0.0145	0.0199
Data dispersion, β_d :	0.26	0.25	0.2	0.35
Uncertainty, β_u :	0.1	0.1	0.1	0.1
Total Dispersion, β :	0.3	0.25	0.25	0.35

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Superior
Data Relevance Superior
Documentation Quality Average
Rationality Superior

Consequence Functions

Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. Tapered gusset plates typically sustain greater damage and there is a higher probability that replacement will be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Cost by Damage State:	1.43E+04	3.53E+04	3.94E+04	1.73E+04	3.91E+04	4.47E+04	1.79E+04	3.99E+04	4.59E+04	1.79E+04	3.99E+04	4.59E+04			
Best fit mean:	2.96E+04			3.37E+04			3.48E+04			3.46E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.24E+04 2.83E+04			4.69E+04 3.13E+04			4.79E+04 3.19E+04			4.79E+04 3.19E+04					
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.32 0.32			0.32 0.32			0.32 0.32					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Time by Damage State:	9.44E+00	2.34E+01	2.60E+01	1.14E+01	2.59E+01	2.96E+01	1.18E+01	2.64E+01	3.03E+01	1.18E+01	2.64E+01	3.03E+01			
Best fit mean:	1.96E+01			2.23E+01			2.29E+01			2.29E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.80E+01 1.87E+01			3.10E+01 2.07E+01			3.17E+01 2.11E+01			3.17E+01 2.11E+01					
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.40 0.40			0.40 0.40			0.40 0.40					
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			60% 0.50			40% 0.50			20% 0.50					

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1033.022b

Special Concentric Braced Frame w HSS braces, tapered gusset plates & design to AISC minimum standard, Single Diagonal Brace, Brace 41 PLF < w < 99 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 30

Construction Quality: Not Specified
Seismic Installation Conditions: Not Specified

Fragility Unit of Measure: EA 1

Demand Parameter (unit): Story Drift Ratio Unit less

Number of Damage States: 4

Damage State:	DS1	DS2	DS3	DS4
Type of Damage State:	Sequential	Sequential	Sequential	Sequential
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)			
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 time brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Illustrations



Damage State Probability:	1.00	1.00	1.00	1.00
Fragility Parameters				
Median Demand, θ :	0.0037	0.0075	0.0145	0.0199
Data dispersion, β_d :	0.26	0.25	0.2	0.35
Uncertainty, β_u :	0.1	0.1	0.1	0.1
Total Dispersion, β :	0.3	0.25	0.25	0.35

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Superior
Data Relevance Superior
Documentation Quality Average
Rationality Superior

Consequence Functions

Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. Tapered gusset plates typically sustain greater damage and there is a higher probability that replacement will be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.43E+04	3.53E+04	3.94E+04	2.17E+04	4.46E+04	5.25E+04	2.45E+04	4.81E+04	5.74E+04	2.45E+04	4.81E+04	5.74E+04			
Best fit mean:	2.96E+04			3.96E+04			4.33E+04			4.33E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.24E+04 2.83E+04			5.35E+04 3.57E+04			5.77E+04 3.85E+04			5.77E+04 3.85E+04					
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.30 0.30			0.30 0.30			0.30 0.30					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.44E+00	2.34E+01	2.60E+01	1.43E+01	2.95E+01	3.47E+01	1.62E+01	3.18E+01	3.80E+01	1.62E+01	3.18E+01	3.80E+01			
Best fit mean:	1.96E+01			2.62E+01			2.87E+01			2.87E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.80E+01 1.87E+01			3.54E+01 2.36E+01			3.82E+01 2.55E+01			3.82E+01 2.55E+01					
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.39 0.39			0.39 0.39			0.39 0.39					
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			60% 0.50			40% 0.50			20% 0.50					

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1033.022c

Special Concentric Braced Frame w HSS braces, tapered gusset plates & design to AISC minimum standard, Single Diagonal Brace, Brace w > 100 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 31

Construction Quality: Not Specified
Seismic Installation Conditions: Not Specified

Fragility Unit of Measure: EA 1

Demand Parameter (unit): Story Drift Ratio Unit less

Number of Damage States: 4

Damage State:	DS1	DS2	DS3	DS4
Type of Damage State:	Sequential	Sequential	Sequential	Sequential
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)			
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 time brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Illustrations



Damage State Probability:	1.00	1.00	1.00	1.00
Fragility Parameters				
Median Demand, θ :	0.0037	0.0075	0.0145	0.0199
Data dispersion, β_d :	0.26	0.25	0.2	0.35
Uncertainty, β_u :	0.1	0.1	0.1	0.1
Total Dispersion, β :	0.3	0.25	0.25	0.35

Correlation (Yes / No) NO

Directionality (Yes / No) YES

Quality Ratings

Data Quality Superior

Data Relevance Superior

Documentation Quality Average

Rationality Superior

Consequence Functions

Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. Tapered gusset plates typically sustain greater damage and there is a higher probability that replacement will be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.43E+04	3.53E+04	3.94E+04	2.75E+04	5.18E+04	6.25E+04	3.19E+04	5.73E+04	7.02E+04	3.19E+04	5.73E+04	7.02E+04			
Best fit mean:	2.96E+04			4.72E+04			5.31E+04			5.31E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.24E+04 2.83E+04			6.22E+04 4.15E+04			6.88E+04 4.59E+04			6.88E+04 4.59E+04					
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.29 0.29			0.28 0.28			0.28 0.28					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.44E+00	2.34E+01	2.60E+01	1.82E+01	3.43E+01	4.13E+01	2.11E+01	3.79E+01	4.64E+01	2.11E+01	3.79E+01	4.64E+01			
Best fit mean:	1.96E+01			3.13E+01			3.51E+01			3.51E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.80E+01 1.87E+01			4.11E+01 2.74E+01			4.55E+01 3.03E+01			4.55E+01 3.03E+01					
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.38 0.38			0.38 0.38			0.38 0.38					
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			60% 0.50			40% 0.50			20% 0.50					

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1033.023a

Special Concentric Braced Frame w HSS braces, tapered gusset plates & design to AISC minimum standard, X Brace, Brace w < 40 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 32

Construction Quality: Not Specified
Seismic Installation Conditions: Not Specified

Fragility Unit of Measure: EA 1
Demand Parameter (unit): Story Drift Ratio Unit less

Quantity Rounding Round Qty? YES
Allow sum by floor or building? NO
Demand Location (floor above?) No

Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 time brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.	

Illustrations

				
none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.011a-DS3-2.JPG	
1.00	1.00	1.00	1.00	

Damage State Probability:	1.00	1.00	1.00	1.00	
Fragility Parameters					
Median Demand, θ :	0.0037	0.0075	0.0145	0.0199	
Data dispersion, β_d :	0.26	0.25	0.2	0.35	
Uncertainty, β_u :	0.1	0.1	0.1	0.1	
Total Dispersion, β :	0.3	0.25	0.25	0.35	
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Superior				
Data Relevance	Superior				
Documentation Quality	Average				
Rationality	Superior				
Consequence Functions					
Repair Description	Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.	Brace has lost significant axial capacity, and replacement of braces is likely required. Tapered gusset plates typically sustain greater damage and there is a higher probability that replacement will be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.	Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed	Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed	

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.56E+04	3.69E+04	4.17E+04	2.10E+04	4.37E+04	5.13E+04	2.22E+04	4.52E+04	5.34E+04	2.22E+04	4.52E+04	5.34E+04			
Best fit mean:	3.14E+04			3.87E+04			4.03E+04			4.03E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.43E+04			2.95E+04			5.25E+04			3.50E+04			5.43E+04		
CV or beta (Min Qty, Max Qty)	0.32			0.32			0.31			0.31			0.30		
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.03E+01	2.44E+01	2.76E+01	1.39E+01	2.89E+01	3.39E+01	1.47E+01	2.99E+01	3.53E+01	1.47E+01	2.99E+01	3.53E+01			
Best fit mean:	2.08E+01			2.56E+01			2.66E+01			2.66E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.93E+01			1.95E+01			3.47E+01			2.32E+01			3.59E+01		
CV or beta (Min Qty, Max Qty)	0.41			0.41			0.40			0.40			0.39		
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard: Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			60% 0.50			40% 0.50			20% 0.50					

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.023b

NISTIR Name

Special Concentric Braced Frame w HSS braces, tapered gusset plates & design to AISC minimum standard, X Brace, Brace 41 PLF < w < 99 PLF

Description

Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 33

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio Unit less

Number of Damage States:

4

Damage State:

DS1

DS2

DS3

DS4

Type of Damage State:

Sequential

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3,DS4)

Descriptions

Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.

Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.

Buckling of brace in excess of 2 time brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.

Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Illustrations

none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.011a-DS3-2.JPG	
1.00	1.00	1.00	1.00	

Damage State Probability:

Fragility Parameters

Median Demand, θ :

0.0037

0.0075

0.0145

0.0199

Data dispersion, β_d :

0.26

0.25

0.2

0.35

Uncertainty, β_u :

0.1

0.1

0.1

0.1

Total Dispersion, β :

0.3

0.25

0.25

0.35

Correlation (Yes / No)

NO

Directionality (Yes / No)

YES

Quality Ratings

Data Quality

Superior

Data Relevance

Superior

Documentation Quality

Average

Rationality

Superior

Consequence Functions

Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. Tapered gusset plates typically sustain greater damage and there is a higher probability that replacement will be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Long Lead Time (Yes / No)

NO

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

1.56E+04 3.69E+04 4.17E+04

3.16E+04 5.70E+04 6.98E+04

3.44E+04 6.05E+04 7.47E+04

3.44E+04 6.05E+04 7.47E+04

3.44E+04 6.05E+04 7.47E+04

Best fit mean:

3.14E+04

5.28E+04

5.65E+04

5.65E+04

5.65E+04

Best Fit Distribution:

Normal

Normal

Normal

Normal

Normal

Quantity Plateau (Min Qty, Max Qty)

5.00 20.00

5.00 20.00

5.00 20.00

5.00 20.00

5.00 20.00

Average Repair Cost (Min Qty, Max Qty)

4.43E+04 2.95E+04

6.83E+04 4.56E+04

7.25E+04 4.84E+04

7.25E+04 4.84E+04

7.25E+04 4.84E+04

CV or beta (Min Qty, Max Qty)

0.32 0.32

0.28 0.28

0.28 0.28

0.28 0.28

0.28 0.28

Quantity Unit:

Each

Each

Each

Each

Each

Repair Time:

Repair Time by Damage State:

1.03E+01 2.44E+01 2.76E+01

2.09E+01 3.77E+01 4.62E+01

2.27E+01 4.00E+01 4.94E+01

2.27E+01 4.00E+01 4.94E+01

2.27E+01 4.00E+01 4.94E+01

Best fit mean:

2.08E+01

3.49E+01

3.74E+01

3.74E+01

3.74E+01

Best Fit Distribution:

Normal

Normal

Normal

Normal

Normal

Quantity Plateau (Min Qty, Max Qty)

5.00 20.00

5.00 20.00

5.00 20.00

5.00 20.00

5.00 20.00

Average Repair Time (Min Qty, Max Qty)

2.93E+01 1.95E+01

4.52E+01 3.02E+01

4.80E+01 3.20E+01

4.80E+01 3.20E+01

4.80E+01 3.20E+01

CV or beta (Min Qty, Max Qty)

0.41 0.41

0.38 0.38

0.37 0.37

0.37 0.37

0.37 0.37

Quantity Unit:

Each

Each

Each

Each

Each

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

NO

NO

NO

NO

NO

Casualty-affected Planar Area (sf) per Normative Unit:

Not Applicable

Not Applicable

Not Applicable

Not Applicable

Not Applicable

Serious Injury (Median, Dispersion)

0% 0.00

0% 0.00

0% 0.00

0% 0.00

0% 0.00

Loss of Life (Median, Dispersion)

0% 0.00

0% 0.00

0% 0.00

0% 0.00

0% 0.00

Post-event Tagging Flag:

NO

YES

YES

YES

YES

Unsafe Placard Trigger (Median, Dispersion)

0% 0.00

60% 0.50

40% 0.50

20% 0.50

20% 0.50

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1033.031a
NISTIR Name Special Concentric Braced Frame, design to AISC minimum standards, Chevron Brace, Brace w < 40 PLF
Description Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 35

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 time brace depth . Yielding and out-of-plane deformation of gusset . Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture . Significant yielding and local buckling in beams and columns adjacent to gusset .	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.011a-DS3-2.JPG		

Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0074	0.0121	0.0152		
Data dispersion, β_d :	0.3	0.25	0.35		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.3	0.25	0.35		

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Superior
Data Relevance Superior
Documentation Quality Superior
Rationality Superior

Consequence Functions
Repair Description
Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.
Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.
Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No) NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.49E+04	3.61E+04	4.05E+04	1.84E+04	4.05E+04	4.66E+04	1.98E+04	4.22E+04	4.90E+04						
Best fit mean:	3.05E+04			3.51E+04			3.70E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	3.97E+04 3.25E+04			4.45E+04 3.64E+04			4.64E+04 3.80E+04								
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.31 0.31			0.31 0.31								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.83E+00	2.39E+01	2.68E+01	1.22E+01	2.68E+01	3.08E+01	1.31E+01	2.79E+01	3.24E+01						
Best fit mean:	2.02E+01			2.32E+01			2.45E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Time (Min Qty, Max Qty)	2.63E+01 2.15E+01			2.95E+01 2.41E+01			3.07E+01 2.51E+01								
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.40 0.40			0.40 0.40								
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	YES			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	60% 0.50			40% 0.50			20% 0.50								

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR ClassificationB1033.031b

NISTIR NameSpecial Concentric Braced Frame, design to AISC minimum standards, Chevron Brace, Brace 41 PLF < w < 99 PLF

DescriptionCosting is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 36

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 time brace depth . Yielding and out-of-plane deformation of gusset . Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture . Significant yielding and local buckling in beams and columns adjacent to gusset .	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.011a-DS3-2.JPG		

Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0074	0.0121	0.0152		
Data dispersion, β_d :	0.3	0.25	0.35		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.3	0.25	0.35		

Correlation (Yes / No)NO
Directionality (Yes / No)YES

Quality Ratings
Data QualitySuperior
Data RelevanceSuperior
Documentation QualitySuperior
RationalitySuperior

Consequence Functions
Repair Description
Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.
Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.
Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.49E+04	3.61E+04	4.05E+04	2.58E+04	4.98E+04	5.98E+04	2.86E+04	5.33E+04	6.47E+04						
Best fit mean:	3.05E+04			4.51E+04			4.88E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	3.97E+04 3.25E+04			5.48E+04 4.48E+04			5.87E+04 4.80E+04								
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.29 0.29			0.29 0.29								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.83E+00	2.39E+01	2.68E+01	1.70E+01	3.30E+01	3.95E+01	1.89E+01	3.53E+01	4.28E+01						
Best fit mean:	2.02E+01			2.99E+01			3.23E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Time (Min Qty, Max Qty)	2.63E+01 2.15E+01			3.63E+01 2.97E+01			3.88E+01 3.18E+01								
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.39 0.39			0.38 0.38								
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	YES			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	60%	0.50		40%	0.50		20%	0.50							

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR ClassificationB1033.031c

NISTIR NameSpecial Concentric Braced Frame, design to AISC minimum standards, Chevron Brace, Brace w > 100 PLF

DescriptionCosting is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 37

Construction Quality:	Not Specified				Quantity Rounding Round Qty? YES Allow sum by floor or building? NO Demand Location (floor above)? No
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 time brace depth . Yielding and out-of-plane deformation of gusset . Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture . Significant yielding and local buckling in beams and columns adjacent to gusset .	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.011a-DS3-2.JPG		

Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0074	0.0121	0.0152		
Data dispersion, β_d :	0.3	0.25	0.35		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.3	0.25	0.35		

Correlation (Yes / No)	NO
Directionality (Yes / No)	YES
Quality Ratings	
Data Quality	Superior
Data Relevance	Superior
Documentation Quality	Superior
Rationality	Superior
Consequence Functions	
Repair Description	Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.
	Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.
	Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.49E+04	3.61E+04	4.05E+04	3.47E+04	6.10E+04	7.54E+04	3.87E+04	6.60E+04	8.24E+04						
Best fit mean:	3.05E+04			5.70E+04			6.23E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	3.97E+04 3.25E+04			6.71E+04 5.49E+04			7.26E+04 5.94E+04								
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.28 0.28			0.27 0.27								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.83E+00	2.39E+01	2.68E+01	2.29E+01	4.04E+01	4.99E+01	2.56E+01	4.37E+01	5.45E+01						
Best fit mean:	2.02E+01			3.77E+01			4.13E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Time (Min Qty, Max Qty)	2.63E+01 2.15E+01			4.44E+01 3.63E+01			4.80E+01 3.93E+01								
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.37 0.37			0.37 0.37								
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	YES			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	60% 0.50			40% 0.50			20% 0.50								

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1033.032a
NISTIR Name Special Concentric Braced Frame, design to AISC minimum standards, Single Diagonal Brace, Brace w < 40 PLF
Description Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 38

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 time brace depth . Yielding and out-of-plane deformation of gusset . Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture . Significant yielding and local buckling in beams and columns adjacent to gusset .	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.011a-DS3-2.JPG		
1.00	1.00	1.00		

Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0074	0.0121	0.0152		
Data dispersion, β_d :	0.3	0.25	0.35		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.3	0.25	0.35		

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Superior
Data Relevance Superior
Documentation Quality Superior
Rationality Superior

Consequence Functions
Repair Description
Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.
Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.
Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No) NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀			
Repair Cost by Damage State:	1.43E+04	3.53E+04	3.94E+04	1.73E+04	3.91E+04	4.47E+04	1.79E+04	3.99E+04	4.59E+04									
Best fit mean:	2.96E+04			3.37E+04			3.46E+04											
Best Fit Distribution:	Normal			Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	3.89E+04			3.18E+04			4.30E+04			3.52E+04			4.39E+04			3.59E+04		
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.32 0.32			0.32 0.32			0.32 0.32								
Quantity Unit:	Each			Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀			
Repair Time by Damage State:	9.44E+00	2.34E+01	2.60E+01	1.14E+01	2.59E+01	2.96E+01	1.18E+01	2.64E+01	3.03E+01									
Best fit mean:	1.96E+01			2.23E+01			2.29E+01											
Best Fit Distribution:	Normal			Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00											
Average Repair Time (Min Qty, Max Qty)	2.57E+01			2.10E+01			2.84E+01			2.33E+01			2.91E+01			2.38E+01		
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.40 0.40			0.40 0.40			0.40 0.40								
Quantity Unit:	Each			Each			Each											
LifeSafety Hazard:	NO			NO			NO											
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable											
Casualty-affected Planar Area (sf) per Normative Unit:																		
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00											
Post-event Tagging Flag:	YES			YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	60% 0.50			40% 0.50			20% 0.50											

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1033.032b

Special Concentric Braced Frame, design to AISC minimum standards, Single Diagonal Brace, Brace 41 PLF < w < 99 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 39

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 time brace depth . Yielding and out-of-plane deformation of gusset . Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture . Significant yielding and local buckling in beams and columns adjacent to gusset .	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.011a-DS3-2.JPG		

Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0074	0.0121	0.0152		
Data dispersion, β_d :	0.3	0.25	0.35		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.3	0.25	0.35		

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Superior
Data Relevance Superior
Documentation Quality Superior
Rationality Superior

Consequence Functions
Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.43E+04	3.53E+04	3.94E+04	2.17E+04	4.46E+04	5.25E+04	2.45E+04	4.81E+04	5.74E+04						
Best fit mean:	2.96E+04			4.33E+04			4.33E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	3.89E+04 0.33 0.33			4.91E+04 0.30 0.30			5.29E+04 0.30 0.30								
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.44E+00	2.34E+01	2.60E+01	1.43E+01	2.95E+01	3.47E+01	1.62E+01	3.18E+01	3.80E+01						
Best fit mean:	1.96E+01			2.62E+01			2.87E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Time (Min Qty, Max Qty)	2.57E+01 0.41 0.41			3.25E+01 0.39 0.39			3.50E+01 0.39 0.39								
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	YES			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	60% 0.50			40% 0.50			20% 0.50								

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR ClassificationB1033.032c

NISTIR NameSpecial Concentric Braced Frame, design to AISC minimum standards, Single Diagonal Brace, Brace w > 100 PLF

DescriptionCosting is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 40

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 time brace depth . Yielding and out-of-plane deformation of gusset . Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture . Significant yielding and local buckling in beams and columns adjacent to gusset .	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.011a-DS3-2.JPG		
1.00	1.00	1.00		

Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0074	0.0121	0.0152		
Data dispersion, β_d :	0.3	0.25	0.35		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.3	0.25	0.35		

Correlation (Yes / No)NO
Directionality (Yes / No)YES

Quality Ratings
Data QualitySuperior
Data RelevanceSuperior
Documentation QualitySuperior
RationalitySuperior

Consequence Functions
Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.43E+04	3.53E+04	3.94E+04	2.75E+04	5.18E+04	6.25E+04	3.19E+04	5.73E+04	7.02E+04						
Best fit mean:	2.96E+04			4.72E+04			5.31E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00		10.00	3.00		10.00	3.00		10.00						
Average Repair Cost (Min Qty, Max Qty)	3.89E+04		3.18E+04	5.70E+04		4.66E+04	6.30E+04		5.16E+04						
CV or beta (Min Qty, Max Qty)	0.33		0.33	0.29		0.29	0.28		0.28						
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.44E+00	2.34E+01	2.60E+01	1.82E+01	3.43E+01	4.13E+01	2.11E+01	3.79E+01	4.64E+01						
Best fit mean:	1.96E+01			3.13E+01			3.51E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00		10.00	3.00		10.00	3.00		10.00						
Average Repair Time (Min Qty, Max Qty)	2.57E+01		2.10E+01	3.77E+01		3.09E+01	4.17E+01		3.41E+01						
CV or beta (Min Qty, Max Qty)	0.41		0.41	0.38		0.38	0.38		0.38						
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	YES			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	60%	0.50		40%	0.50		20%	0.50							
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

B1033.033a

NISTIR Name

Special Concentric Braced Frame, design to AISC minimum standards, X Brace, Brace w < 40 PLF

Description

Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 41

Construction Quality: Not Specified

Seismic Installation Conditions: Not Specified

Fragility Unit of Measure: EA 1

Demand Parameter (unit): Story Drift Ratio Unit less

Number of Damage States: 4

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Sequential

Seq(DS1,DS2,DS3,DS4)

Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.

Sequential

Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.

Sequential

Buckling of brace in excess of 2 times brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.

Sequential

Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibly local buckling and cracking in the yielded areas.

Quantity Rounding Round Qty? YES
Allow sum by floor or building? NO
Demand Location (floor above?) No

Illustrations



Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

none

1.00

B1033.001a-DS2-1.JPG

1.00

B1033.001a-DS3-1.JPG

1.00

B1033.011a-DS3-2.JPG

1.00

0.0038

0.29

0.1

0.3

NO

YES

Marginal

Average

Marginal

Average

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Long Lead Time (Yes / No)

NO

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.56E+04	3.69E+04	4.17E+04	2.10E+04	4.37E+04	5.13E+04	2.22E+04	4.52E+04	5.34E+04	2.22E+04	4.52E+04	5.34E+04			
Best fit mean:	3.14E+04			3.87E+04			4.03E+04			4.03E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00			3.00 10.00					
Average Repair Cost (Min Qty, Max Qty)	4.06E+04			4.81E+04			4.98E+04			4.98E+04			4.07E+04		
CV or beta (Min Qty, Max Qty)	0.32			0.31			0.30			0.30			0.30		
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.03E+01	2.44E+01	2.76E+01	1.39E+01	2.89E+01	3.39E+01	1.47E+01	2.99E+01	3.53E+01	1.47E+01	2.99E+01	3.53E+01			
Best fit mean:	2.08E+01			2.56E+01			2.66E+01			2.66E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00			3.00 10.00					
Average Repair Time (Min Qty, Max Qty)	2.69E+01			3.18E+01			3.29E+01			3.29E+01			2.69E+01		
CV or beta (Min Qty, Max Qty)	0.41			0.40			0.39			0.39			0.39		
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			60% 0.50			40% 0.50			20% 0.50					

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1033.033b
NISTIR Name Special Concentric Braced Frame, design to AISC minimum standards, X Brace, Brace 41 PLF < w < 99 PLF
Description Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 42

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	Seq(DS1,DS2,DS3,DS4) Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.		Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.		
			Buckling of brace in excess of 2 times brace depth . Yielding and out-of-plane deformation of gusset . Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture . Significant yielding and local buckling in beams and columns adjacent to gusset .		
			Fracture of brace or gusset . Buckling of gusset . Severe yielding of beams and columns adjacent to the gusset with possibly local buckling and cracking in the yielded areas.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Illustrations

				
none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.011a-DS3-2.JPG	
1.00	1.00	1.00	1.00	

Damage State Probability:	1.00	1.00	1.00	1.00	
Fragility Parameters					
Median Demand, θ :	0.0038	0.0075	0.0145	0.0185	
Data dispersion, β_d :	0.29	0.50	0.1	0.25	
Uncertainty, β_u :	0.1	0.25	0.25	0.25	
Total Dispersion, β :	0.3	0.55	0.25	0.35	
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Average				
Documentation Quality	Marginal				
Rationality	Average				
Consequence Functions					
Repair Description	<div>Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.</div> <div>Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.</div> <div>Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed</div> <div>Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed</div>				

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.56E+04	3.69E+04	4.17E+04	3.16E+04	5.70E+04	6.98E+04	3.44E+04	6.05E+04	7.47E+04	3.44E+04	6.05E+04	7.47E+04			
Best fit mean:	3.14E+04			5.28E+04			5.65E+04			5.65E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00			3.00 10.00					
Average Repair Cost (Min Qty, Max Qty)	4.06E+04			6.27E+04			6.65E+04			5.44E+04			6.65E+04 5.44E+04		
CV or beta (Min Qty, Max Qty)	0.32 0.32			0.28 0.28			0.28 0.28			0.28 0.28					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.03E+01	2.44E+01	2.76E+01	2.09E+01	3.77E+01	4.62E+01	2.27E+01	4.00E+01	4.94E+01	2.27E+01	4.00E+01	4.94E+01			
Best fit mean:	2.08E+01			3.49E+01			3.74E+01			3.74E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00			3.00 10.00					
Average Repair Time (Min Qty, Max Qty)	2.69E+01			4.15E+01			4.40E+01			3.60E+01			4.40E+01 3.60E+01		
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.38 0.38			0.37 0.37			0.37 0.37					
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			60% 0.50			40% 0.50			20% 0.50					

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1033.033c

Special Concentric Braced Frame, design to AISC minimum standards, X Brace, Brace w > 100 PLF
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 43

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3,DS4)				
Descriptions	Seq(DS1,DS2,DS3,DS4) Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.		Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.		
			Buckling of brace in excess of 2 times brace depth . Yielding and out-of-plane deformation of gusset . Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture . Significant yielding and local buckling in beams and columns adjacent to gusset .		
			Fracture of brace or gusset . Buckling of gusset . Severe yielding of beams and columns adjacent to the gusset with possibly local buckling and cracking in the yielded areas.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Illustrations

none	B1033.001a-DS2-1.JPG	B1033.001a-DS3-1.JPG	B1033.011a-DS3-2.JPG	
1.00	1.00	1.00	1.00	

Damage State Probability:	1.00	1.00	1.00	1.00	
Fragility Parameters					
Median Demand, θ :	0.0038	0.0075	0.0145	0.0185	
Data dispersion, β_d :	0.29	0.50	0.1	0.25	
Uncertainty, β_u :	0.1	0.25	0.25	0.25	
Total Dispersion, β :	0.3	0.55	0.25	0.35	

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Marginal
Data Relevance Average
Documentation Quality Marginal
Rationality Average
Consequence Functions

Repair Description
Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.
Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.
Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed
Brace and or gusset have fractured and require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.56E+04	3.69E+04	4.17E+04	4.37E+04	7.22E+04	9.11E+04	4.81E+04	7.77E+04	9.88E+04	4.81E+04	7.77E+04	9.88E+04			
Best fit mean:	3.14E+04			6.90E+04			7.48E+04			7.48E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	4.98E+04			9.74E+04			1.05E+05			5.82E+04			1.05E+05 5.82E+04		
CV or beta (Min Qty, Max Qty)	0.32 0.32			0.27 0.27			0.26 0.26			0.26 0.26					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.03E+01	2.44E+01	2.76E+01	2.89E+01	4.78E+01	6.03E+01	3.18E+01	5.14E+01	6.54E+01	3.18E+01	5.14E+01	6.54E+01			
Best fit mean:	2.08E+01			4.56E+01			4.95E+01			4.95E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	3.30E+01			6.45E+01			6.94E+01			3.85E+01			6.94E+01 3.85E+01		
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.37 0.37			0.36 0.36			0.36 0.36					
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Casualty-affected Planar Area (sf) per Normative Unit:															
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			60% 0.50			40% 0.50			20% 0.50					

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1033.041a
NISTIR Name Special Concentric Braced Frame w double angle braces, Chevron Brace, Brace w < 40 PLF
Description Costing on a per bay basis, equivalent to AISC minimum SCBF criteria. Costing does not include fireproofing removal or reapplication cost.

Line 44

Construction Quality:	Not Specified				Quantity Rounding Round Qty? YES Allow sum by floor or building? NO Demand Location (floor above)? No
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.00256	0.0048	0.0112		
Data dispersion, β_d :	0.28	0.30	0.5		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.3	0.3	0.3		

Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Average				
Documentation Quality	Marginal				
Rationality	Average				
Consequence Functions					
Repair Description	Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.	Brace has lost significant axial capacity, and replacement braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.	Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed		

Long Lead Time (Yes / No)	NO			NO			NO								
Repair Costs:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Cost by Damage State:	1.49E+04	3.61E+04	4.05E+04	1.89E+04	4.12E+04	4.76E+04	2.03E+04	4.29E+04	5.00E+04						
Best fit mean:	3.05E+04			3.59E+04			3.77E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00						
Average Repair Cost (Min Qty, Max Qty)	4.87E+04		2.71E+04	5.56E+04		3.09E+04	5.79E+04		3.22E+04						
CV or beta (Min Qty, Max Qty)	0.33		0.33	0.31		0.31	0.31		0.31						
Quantity Unit:	Each			Each			Each								
Repair Time:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Time by Damage State:	9.83E+00	2.39E+01	2.68E+01	1.25E+01	2.73E+01	3.15E+01	1.34E+01	2.84E+01	3.31E+01						
Best fit mean:	2.02E+01			2.37E+01			2.49E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00						
Average Repair Time (Min Qty, Max Qty)	3.22E+01		1.79E+01	3.68E+01		2.04E+01	3.83E+01		2.13E+01						
CV or beta (Min Qty, Max Qty)	0.41		0.41	0.40		0.40	0.40		0.40						
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		60%	0.50		40%	0.50							
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1033.041b
NISTIR Name Special Concentric Braced Frame w double angle braces, Chevron Brace, Brace 41 PLF < w < 99 PLF
Description Costing on a per bay basis, equivalent to AISC minimum SCBF criteria. Costing does not include fireproofing removal or reapplication cost.

Line 45

Construction Quality:	Not Specified				Quantity Rounding Round Qty? YES Allow sum by floor or building? NO Demand Location (floor above)? No
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.00256	0.0048	0.0112		
Data dispersion, β_d :	0.28	0.30	0.5		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.3	0.3	0.3		

Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Average				
Documentation Quality	Marginal				
Rationality	Average				
Consequence Functions					
Repair Description	Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.	Brace has lost significant axial capacity, and replacement braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.	Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed		

Long Lead Time (Yes / No)				NO			NO			NO								
Repair Costs: Repair Cost by Damage State: Best fit mean: Best Fit Distribution: Quantity Plateau (Min Qty, Max Qty) Average Repair Cost (Min Qty, Max Qty) CV or beta (Min Qty, Max Qty) Quantity Unit:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
	1.49E+04	3.61E+04	4.05E+04	2.72E+04	5.15E+04	6.21E+04	3.00E+04	5.50E+04	6.70E+04									
	3.05E+04			4.69E+04			5.06E+04											
	Normal			Normal			Normal											
	5.00 20.00			5.00 20.00			5.00 20.00											
	4.87E+04 2.71E+04			6.95E+04 3.86E+04			7.42E+04 4.12E+04											
	0.33 0.33			0.29 0.29			0.29 0.29											
Each			Each			Each												
Repair Time: Repair Time by Damage State: Best fit mean: Best Fit Distribution: Quantity Plateau (Min Qty, Max Qty) Average Repair Time (Min Qty, Max Qty) CV or beta (Min Qty, Max Qty) Quantity Unit:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
	9.83E+00	2.39E+01	2.68E+01	1.80E+01	3.41E+01	4.11E+01	1.98E+01	3.64E+01	4.43E+01									
	2.02E+01			3.10E+01			3.35E+01											
	Normal			Normal			Normal											
	5.00 20.00			5.00 20.00			5.00 20.00											
	3.22E+01 1.79E+01			4.60E+01 2.55E+01			4.91E+01 2.73E+01											
	0.41 0.41			0.38 0.38			0.38 0.38											
Each			Each			Each												
LifeSafety Hazard: Potential non-collapse casualties? (Yes / No) Casualty-affected Planar Area (sf) per Normative Unit: Serious Injury (Median, Dispersion) Loss of Life (Median, Dispersion) Post-event Tagging Flag: Unsafe Placard Trigger (Median, Dispersion) Comments: Date Created: Approved (YES / NO)? Official (YES / NO) ? Author: Revisions:	NO			NO			NO											
	Not Applicable			Not Applicable			Not Applicable											
	0% 0.00			0% 0.00			0% 0.00											
	0% 0.00			0% 0.00			0% 0.00											
	NO			YES			YES											
	0% 0.00			60% 0.50			40% 0.50											
	None															Root Cost Multiplier: 1		
Not Given																		
By User																		
By User																		
Not Given																		
2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.																		

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1033.041c
NISTIR Name Special Concentric Braced Frame w double angle braces, Chevron Brace, Brace w > 100 PLF
Description Costing on a per bay basis, equivalent to AISC minimum SCBF criteria. Costing does not include fireproofing removal or reapplication cost.

Line 46

Construction Quality:	Not Specified				Quantity Rounding Round Qty? YES Allow sum by floor or building? NO Demand Location (floor above)? No
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.00256	0.0048	0.0112		
Data dispersion, β_d :	0.28	0.30	0.5		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.3	0.3	0.3		

Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Average				
Documentation Quality	Marginal				
Rationality	Average				
Consequence Functions					
Repair Description	Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.	Brace has lost significant axial capacity, and replacement braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.	Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed		

Long Lead Time (Yes / No)	NO			NO			NO														
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀						
Repair Cost by Damage State:	1.49E+04	3.61E+04	4.05E+04	3.70E+04	6.38E+04	7.94E+04	4.10E+04	6.88E+04	8.64E+04												
Best fit mean:	3.05E+04			6.00E+04			6.54E+04														
Best Fit Distribution:	Normal			Normal			Normal														
Quantity Plateau (Min Qty, Max Qty)	5.00		15.00	5.00		15.00	5.00		15.00												
Average Repair Cost (Min Qty, Max Qty)	4.33E+04		2.89E+04	7.66E+04		5.10E+04	8.26E+04		5.50E+04												
CV or beta (Min Qty, Max Qty)	0.33		0.33	0.28		0.28	0.27		0.27												
Quantity Unit:	Each			Each			Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀						
Repair Time by Damage State:	9.83E+00	2.39E+01	2.68E+01	2.45E+01	4.22E+01	5.25E+01	2.71E+01	4.55E+01	5.72E+01												
Best fit mean:	2.02E+01			3.97E+01			4.33E+01														
Best Fit Distribution:	Normal			Normal			Normal														
Quantity Plateau (Min Qty, Max Qty)	5.00		15.00	5.00		15.00	5.00		15.00												
Average Repair Time (Min Qty, Max Qty)	2.87E+01		1.91E+01	5.07E+01		3.38E+01	5.46E+01		3.64E+01												
CV or beta (Min Qty, Max Qty)	0.41		0.41	0.37		0.37	0.37		0.37												
Quantity Unit:	Each			Each			Each														
LifeSafety Hazard:																					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00													
Post-event Tagging Flag:	NO			YES			YES														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		60%	0.50		40%	0.50													
Comments:	None																				
Date Created:	Not Given																				
Approved (YES / NO)?	By User																				
Official (YES / NO) ?	By User																				
Author:	Not Given																				
Revisions:	2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.																				

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1033.042a
NISTIR Name Special Concentric Braced Frame w double angle braces, Single Diagonal Brace, Brace w < 40 PLF
Description Costing on a per bay basis, equivalent to AISC minimum SCBF criteria. Costing does not include fireproofing removal or reapplication cost.

Line 47

Construction Quality:	Not Specified				Quantity Rounding Round Qty? YES Allow sum by floor or building? NO Demand Location (floor above)? No
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.00256	0.0048	0.0112		
Data dispersion, β_d :	0.28	0.30	0.5		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.3	0.3	0.3		

Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Average				
Documentation Quality	Marginal				
Rationality	Average				
Consequence Functions					
Repair Description	Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.	Brace has lost significant axial capacity, and replacement braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.	Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed		

Long Lead Time (Yes / No)	NO			NO			NO														
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀						
Repair Cost by Damage State:	1.43E+04	3.53E+04	3.94E+04	1.77E+04	3.96E+04	4.54E+04	1.83E+04	4.04E+04	4.66E+04												
Best fit mean:	2.96E+04			3.42E+04			3.51E+04														
Best Fit Distribution:	Normal			Normal			Normal														
Quantity Plateau (Min Qty, Max Qty)	5.00		15.00	5.00		15.00	5.00		15.00												
Average Repair Cost (Min Qty, Max Qty)	4.24E+04		2.83E+04	4.75E+04		3.16E+04	4.85E+04		3.23E+04												
CV or beta (Min Qty, Max Qty)	0.33		0.33	0.32		0.32	0.31		0.31												
Quantity Unit:	Each			Each			Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀						
Repair Time by Damage State:	9.44E+00	2.34E+01	2.60E+01	1.17E+01	2.62E+01	3.00E+01	1.21E+01	2.67E+01	3.08E+01												
Best fit mean:	1.96E+01			2.26E+01			2.32E+01														
Best Fit Distribution:	Normal			Normal			Normal														
Quantity Plateau (Min Qty, Max Qty)	5.00		15.00	5.00		15.00	5.00		15.00												
Average Repair Time (Min Qty, Max Qty)	2.80E+01		1.87E+01	3.14E+01		2.09E+01	3.21E+01		2.14E+01												
CV or beta (Min Qty, Max Qty)	0.41		0.41	0.40		0.40	0.40		0.40												
Quantity Unit:	Each			Each			Each														
LifeSafety Hazard:																					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00													
Post-event Tagging Flag:	NO			YES			YES														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		60%	0.50		40%	0.50													
Comments:	None																				
Date Created:	Not Given																				
Approved (YES / NO)?	By User																				
Official (YES / NO) ?	By User																				
Author:	Not Given																				
Revisions:	2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.																				

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1033.042b
NISTIR Name Special Concentric Braced Frame w double angle braces, Single Diagonal Brace, Brace 41 PLF < w < 99 PLF
Description Costing on a per bay basis, equivalent to AISC minimum SCBF criteria. Costing does not include fireproofing removal or reapplication cost.

Line 48

Construction Quality:	Not Specified				Quantity Rounding Round Qty? YES Allow sum by floor or building? NO Demand Location (floor above)? No
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.00256	0.0048	0.0112		
Data dispersion, β_d :	0.28	0.30	0.5		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.3	0.3	0.3		

Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Average				
Documentation Quality	Marginal				
Rationality	Average				
Consequence Functions					
Repair Description	Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.	Brace has lost significant axial capacity, and replacement braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.	Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed		

Long Lead Time (Yes / No)	NO			NO			NO								
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.43E+04	3.53E+04	3.94E+04	2.26E+04	4.57E+04	5.41E+04	2.54E+04	4.92E+04	5.90E+04						
Best fit mean:	2.96E+04			4.08E+04			4.45E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 15.00			5.00 15.00			5.00 15.00								
Average Repair Cost (Min Qty, Max Qty)	4.24E+04 2.83E+04			5.49E+04 3.66E+04			5.91E+04 3.94E+04								
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.30 0.30			0.29 0.29								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.44E+00	2.34E+01	2.60E+01	1.49E+01	3.03E+01	3.58E+01	1.68E+01	3.26E+01	3.90E+01						
Best fit mean:	1.96E+01			2.70E+01			2.95E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 15.00			5.00 15.00			5.00 15.00								
Average Repair Time (Min Qty, Max Qty)	2.80E+01 1.87E+01			3.63E+01 2.42E+01			3.91E+01 2.61E+01								
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.39 0.39			0.39 0.39								
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			60% 0.50			40% 0.50								

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1033.042c
NISTIR Name Special Concentric Braced Frame w double angle braces, Single Diagonal Brace, Brace w > 100 PLF
Description Costing on a per bay basis, equivalent to AISC minimum SCBF criteria. Costing does not include fireproofing removal or reapplication cost.

Line 49

Construction Quality:	Not Specified				Quantity Rounding Round Qty? YES Allow sum by floor or building? NO Demand Location (floor above)? No
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.00256	0.0048	0.0112		
Data dispersion, β_d :	0.28	0.30	0.5		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.3	0.3	0.3		

Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Average				
Documentation Quality	Marginal				
Rationality	Average				
Consequence Functions					
Repair Description	Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.	Brace has lost significant axial capacity, and replacement braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.	Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed		

Long Lead Time (Yes / No)	NO			NO			NO														
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀						
Repair Cost by Damage State:	1.43E+04	3.53E+04	3.94E+04	2.90E+04	5.37E+04	6.52E+04	3.34E+04	5.92E+04	7.29E+04												
Best fit mean:	2.96E+04			4.93E+04			5.52E+04														
Best Fit Distribution:	Normal			Normal			Normal														
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00												
Average Repair Cost (Min Qty, Max Qty)	4.42E+04		3.00E+04	6.72E+04		4.57E+04	7.40E+04		5.04E+04												
CV or beta (Min Qty, Max Qty)	0.33		0.33	0.29		0.29	0.28		0.28												
Quantity Unit:	Each			Each			Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀						
Repair Time by Damage State:	9.44E+00	2.34E+01	2.60E+01	1.92E+01	3.56E+01	4.31E+01	2.21E+01	3.92E+01	4.82E+01												
Best fit mean:	1.96E+01			3.26E+01			3.65E+01														
Best Fit Distribution:	Normal			Normal			Normal														
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00												
Average Repair Time (Min Qty, Max Qty)	2.92E+01		1.99E+01	4.45E+01		3.02E+01	4.90E+01		3.33E+01												
CV or beta (Min Qty, Max Qty)	0.41		0.41	0.38		0.38	0.37		0.37												
Quantity Unit:	Each			Each			Each														
LifeSafety Hazard:																					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00													
Post-event Tagging Flag:	NO			YES			YES														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		60%	0.50		40%	0.50													
Comments:	None																				
Date Created:	Not Given																				
Approved (YES / NO)?	By User																				
Official (YES / NO) ?	By User																				
Author:	Not Given																				
Revisions:	2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.																				

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1033.043a
NISTIR Name Special Concentric Braced Frame w double angle braces, X Brace, Brace w < 40 PLF
Description Costing on a per bay basis, equivalent to AISC minimum SCBF criteria. Costing does not include fireproofing removal or reapplication cost.

Line 50

Construction Quality:	Not Specified				Quantity Rounding Round Qty? YES Allow sum by floor or building? NO Demand Location (floor above)? No
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.00256	0.0048	0.0112		
Data dispersion, β_d :	0.28	0.30	0.5		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.3	0.3	0.3		

Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Average				
Documentation Quality	Marginal				
Rationality	Average				
Consequence Functions					
Repair Description	Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.	Brace has lost significant axial capacity, and replacement braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.	Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed		

Long Lead Time (Yes / No)	NO			NO			NO														
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀						
Repair Cost by Damage State:	1.56E+04	3.69E+04	4.17E+04	2.17E+04	4.47E+04	5.27E+04	2.29E+04	4.62E+04	5.48E+04												
Best fit mean:	3.14E+04			3.97E+04			4.13E+04														
Best Fit Distribution:	Normal			Normal			Normal														
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00												
Average Repair Cost (Min Qty, Max Qty)	4.62E+04		3.14E+04	5.59E+04		3.80E+04	5.78E+04		3.93E+04												
CV or beta (Min Qty, Max Qty)	0.32		0.32	0.30		0.30	0.30		0.30												
Quantity Unit:	Each			Each			Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀						
Repair Time by Damage State:	1.03E+01	2.44E+01	2.76E+01	1.43E+01	2.96E+01	3.48E+01	1.51E+01	3.06E+01	3.62E+01												
Best fit mean:	2.08E+01			2.63E+01			2.73E+01														
Best Fit Distribution:	Normal			Normal			Normal														
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00												
Average Repair Time (Min Qty, Max Qty)	3.05E+01		2.08E+01	3.70E+01		2.51E+01	3.82E+01		2.60E+01												
CV or beta (Min Qty, Max Qty)	0.41		0.41	0.39		0.39	0.39		0.39												
Quantity Unit:	Each			Each			Each														
LifeSafety Hazard:																					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00													
Post-event Tagging Flag:	NO			YES			YES														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		60%	0.50		40%	0.50													
Comments:	None																				
Date Created:	Not Given																				
Approved (YES / NO)?	By User																				
Official (YES / NO) ?	By User																				
Author:	Not Given																				
Revisions:	2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.																				

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1033.043b
NISTIR Name Special Concentric Braced Frame w double angle braces, X Brace, Brace 41 PLF < w < 99 PLF
Description Costing on a per bay basis, equivalent to AISC minimum SCBF criteria. Costing does not include fireproofing removal or reapplication cost.

Line 51

Construction Quality:	Not Specified				Quantity Rounding Round Qty? YES Allow sum by floor or building? NO Demand Location (floor above)? No
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.00256	0.0048	0.0112		
Data dispersion, β_d :	0.28	0.30	0.5		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.3	0.3	0.3		

Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Average				
Documentation Quality	Marginal				
Rationality	Average				
Consequence Functions					
Repair Description	Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.	Brace has lost significant axial capacity, and replacement braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.	Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed		

Long Lead Time (Yes / No)	NO			NO			NO														
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀						
Repair Cost by Damage State:	1.56E+04	3.69E+04	4.17E+04	3.33E+04	5.92E+04	7.29E+04	3.61E+04	6.27E+04	7.78E+04												
Best fit mean:	3.14E+04			5.51E+04			5.88E+04														
Best Fit Distribution:	Normal			Normal			Normal														
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00												
Average Repair Cost (Min Qty, Max Qty)	4.62E+04		3.14E+04	7.40E+04		5.03E+04	7.84E+04		5.33E+04												
CV or beta (Min Qty, Max Qty)	0.32		0.32	0.28		0.28	0.28		0.28												
Quantity Unit:	Each			Each			Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀						
Repair Time by Damage State:	1.03E+01	2.44E+01	2.76E+01	2.20E+01	3.92E+01	4.82E+01	2.39E+01	4.15E+01	5.15E+01												
Best fit mean:	2.08E+01			3.65E+01			3.89E+01														
Best Fit Distribution:	Normal			Normal			Normal														
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00												
Average Repair Time (Min Qty, Max Qty)	3.05E+01		2.08E+01	4.90E+01		3.33E+01	5.19E+01		3.53E+01												
CV or beta (Min Qty, Max Qty)	0.41		0.41	0.38		0.38	0.37		0.37												
Quantity Unit:	Each			Each			Each														
LifeSafety Hazard:																					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00													
Post-event Tagging Flag:	NO			YES			YES														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		60%	0.50		40%	0.50													
Comments:	None																				
Date Created:	Not Given																				
Approved (YES / NO)?	By User																				
Official (YES / NO) ?	By User																				
Author:	Not Given																				
Revisions:	2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.																				

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1033.043c
NISTIR Name Special Concentric Braced Frame w double angle braces, X Brace, Brace w > 100 PLF
Description Costing on a per bay basis, equivalent to AISC minimum SCBF criteria. Costing does not include fireproofing removal or reapplication cost.

Line 52

Construction Quality:	Not Specified				Quantity Rounding Round Qty? YES Allow sum by floor or building? NO Demand Location (floor above)? No
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual buckling of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.00256	0.0048	0.0112		
Data dispersion, β_d :	0.28	0.30	0.5		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.3	0.3	0.3		

Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Average				
Documentation Quality	Marginal				
Rationality	Average				
Consequence Functions					
Repair Description	Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.	Brace has lost significant axial capacity, and replacement braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.	Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed		

Long Lead Time (Yes / No)				NO			NO			NO								
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
	Repair Cost by Damage State:			1.56E+04	3.69E+04	4.17E+04	4.68E+04	7.60E+04	9.64E+04	5.12E+04	8.15E+04	1.04E+05						
	Best fit mean:			3.14E+04			7.30E+04			7.89E+04								
	Best Fit Distribution:			Normal			Normal			Normal								
	Quantity Plateau (Min Qty, Max Qty)			3.00		7.00	3.00		7.00	3.00		7.00						
	Average Repair Cost (Min Qty, Max Qty)			4.62E+04		3.14E+04	9.50E+04		6.46E+04	1.02E+05		6.93E+04						
	CV or beta (Min Qty, Max Qty)			0.32		0.32	0.26		0.26	0.26		0.26						
Repair Time:	Quantity Unit:			Each			Each			Each								
	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
	Repair Time by Damage State:			1.03E+01	2.44E+01	2.76E+01	3.09E+01	5.03E+01	6.38E+01	3.39E+01	5.39E+01	6.89E+01						
	Best fit mean:			2.08E+01			4.83E+01			5.22E+01								
	Best Fit Distribution:			Normal			Normal			Normal								
	Quantity Plateau (Min Qty, Max Qty)			3.00		7.00	3.00		7.00	3.00		7.00						
	Average Repair Time (Min Qty, Max Qty)			3.05E+01		2.08E+01	6.29E+01		4.28E+01	6.74E+01		4.58E+01						
CV or beta (Min Qty, Max Qty)			0.41		0.41	0.36		0.36	0.36		0.36							
LifeSafety Hazard:	Quantity Unit:			Each			Each			Each								
	Potential non-collapse casualties? (Yes / No)			NO			NO			NO								
	Casualty-affected Planar Area (sf) per Normative Unit:			Not Applicable			Not Applicable			Not Applicable								
	Serious Injury (Median, Dispersion)			0%		0.00	0%		0.00	0%		0.00						
	Loss of Life (Median, Dispersion)			0%		0.00	0%		0.00	0%		0.00						
	Post-event Tagging Flag:			NO			YES			YES								
	Unsafe Placard Trigger (Median, Dispersion)			0%		0.00	60%		0.50	40%		0.50						
Comments:	None																	
	Not Given																	
	By User																	
	By User																	
	Not Given																	
Revisions:	2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.																	

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1033.051a
NISTIR Name Ordinary Concentric Braced Frame w compact braces, Chevron Brace, Brace w < 40 PLF
Description Costing on a per bay basis, braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 53

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential		Sequential		Sequential
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	<div>Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual deformation of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.</div> <div>Brace has buckled but residual displacement does not exceed two times brace depth. Brace has not fractured. Gusset plate exhibits extensive yielding. Yielding extends well into the members.</div> <div>Brace has fractured. Gusset plate has torn, possibly completely free of framing. Local buckling of flanges and web of framing members. Bolt fractures in beam-column connections.</div>				

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.00159	0.01	0.0178		
Data dispersion, β_d :	0.66	0.15	0.43		
Uncertainty, β_u :	0.25	0.25	0.25		
Total Dispersion, β :	0.7	0.3	0.3		

Correlation (Yes / No) NO
Directionality (Yes / No) YES
Quality Ratings
Data Quality Not Rated
Data Relevance Marginal
Documentation Quality average
Rationality Superior
Consequence Functions
Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Replace brace. Gusset plate must be replaced 50% of the time. Heat straightening of deformed beams and columns may be required.

Replace brace. Gusset plate must be replaced 90% of the time. Replacement of portions (deformed flanges, webs) of permanently deformed beams and columns likely required.

Long Lead Time (Yes / No)	NO			NO			NO								
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.45E+04	3.56E+04	3.99E+04	1.80E+04	4.00E+04	4.60E+04	1.94E+04	4.17E+04	4.84E+04						
Best fit mean:	3.00E+04			3.46E+04			3.65E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00	7.00		3.00	7.00		3.00	7.00							
Average Repair Cost (Min Qty, Max Qty)	4.45E+04	3.03E+04		5.00E+04	3.40E+04		5.22E+04	3.55E+04							
CV or beta (Min Qty, Max Qty)	0.33	0.33		0.32	0.32		0.31	0.31							
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.57E+00	2.36E+01	2.64E+01	1.19E+01	2.65E+01	3.04E+01	1.28E+01	2.76E+01	3.20E+01						
Best fit mean:	1.98E+01			2.29E+01			2.41E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00	7.00		3.00	7.00		3.00	7.00							
Average Repair Time (Min Qty, Max Qty)	2.95E+01	2.00E+01		3.31E+01	2.25E+01		3.45E+01	2.35E+01							
CV or beta (Min Qty, Max Qty)	0.41	0.41		0.40	0.40		0.40	0.40							
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		40%	0.50		20%	0.50							

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1033.051b
NISTIR Name Ordinary Concentric Braced Frame w compact braces, Chevron Brace, Brace w, 41 PLF < w < 99 PLF
Description Costing on a per bay basis, braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 54

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential		Sequential		Sequential
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	<div>Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual deformation of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.</div> <div>Brace has buckled but residual displacement does not exceed two times brace depth. Brace has not fractured. Gusset plate exhibits extensive yielding. Yielding extends well into the members.</div> <div>Brace has fractured. Gusset plate has torn, possibly completely free of framing. Local buckling of flanges and web of framing members. Bolt fractures in beam-column connections.</div>				

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.00159	0.01	0.0178		
Data dispersion, β_d :	0.66	0.15	0.43		
Uncertainty, β_u :	0.25	0.25	0.25		
Total Dispersion, β :	0.7	0.3	0.3		

Correlation (Yes / No) NO
Directionality (Yes / No) YES
Quality Ratings
Data Quality Not Rated
Data Relevance Marginal
Documentation Quality average
Rationality Superior
Consequence Functions
Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Replace brace. Gusset plate must be replaced 50% of the time. Heat straightening of deformed beams and columns may be required.

Replace brace. Gusset plate must be replaced 90% of the time. Replacement of portions (deformed flanges, webs) of permanently deformed beams and columns likely required.

Long Lead Time (Yes / No)	NO			NO			NO								
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.45E+04	3.56E+04	3.99E+04	2.51E+04	4.89E+04	5.85E+04	2.79E+04	5.24E+04	6.34E+04						
Best fit mean:	3.00E+04			4.41E+04			4.79E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00	7.00		3.00	7.00		3.00	7.00							
Average Repair Cost (Min Qty, Max Qty)	4.45E+04	3.03E+04		6.12E+04	4.16E+04		6.55E+04	4.46E+04							
CV or beta (Min Qty, Max Qty)	0.33	0.33		0.30	0.30		0.29	0.29							
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.57E+00	2.36E+01	2.64E+01	1.66E+01	3.24E+01	3.87E+01	1.84E+01	3.47E+01	4.19E+01						
Best fit mean:	1.98E+01			2.92E+01			3.17E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00	7.00		3.00	7.00		3.00	7.00							
Average Repair Time (Min Qty, Max Qty)	2.95E+01	2.00E+01		4.05E+01	2.75E+01		4.34E+01	2.95E+01							
CV or beta (Min Qty, Max Qty)	0.41	0.41		0.39	0.39		0.38	0.38							
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		40%	0.50		20%	0.50							

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1033.051c
NISTIR Name Ordinary Concentric Braced Frame w compact braces, Chevron Brace, Brace w > 100 PLF
Description Costing on a per bay basis, braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 55

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential		Sequential		Sequential
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	<div>Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual deformation of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.</div> <div>Brace has buckled but residual displacement does not exceed two times brace depth. Brace has not fractured. Gusset plate exhibits extensive yielding. Yielding extends well into the members.</div> <div>Brace has fractured. Gusset plate has torn, possibly completely free of framing. Local buckling of flanges and web of framing members. Bolt fractures in beam-column connections.</div>				

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.00159	0.01	0.0178		
Data dispersion, β_d :	0.66	0.15	0.43		
Uncertainty, β_u :	0.25	0.25	0.25		
Total Dispersion, β :	0.7	0.3	0.3		

Correlation (Yes / No) NO
Directionality (Yes / No) YES
Quality Ratings
Data Quality Not Rated
Data Relevance Marginal
Documentation Quality average
Rationality Superior
Consequence Functions
Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Replace brace. Gusset plate must be replaced 50% of the time. Heat straightening of deformed beams and columns may be required.

Replace brace. Gusset plate must be replaced 90% of the time. Replacement of portions (deformed flanges, webs) of permanently deformed beams and columns likely required.

Long Lead Time (Yes / No)	NO			NO			NO								
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.45E+04	3.56E+04	3.99E+04	3.40E+04	6.01E+04	7.41E+04	3.80E+04	6.51E+04	8.11E+04						
Best fit mean:	3.00E+04			5.60E+04			6.14E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00	7.00		3.00	7.00		3.00	7.00							
Average Repair Cost (Min Qty, Max Qty)	4.45E+04	3.03E+04		7.51E+04	5.11E+04		8.14E+04	5.53E+04							
CV or beta (Min Qty, Max Qty)	0.33	0.33		0.28	0.28		0.27	0.27							
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.57E+00	2.36E+01	2.64E+01	2.25E+01	3.98E+01	4.90E+01	2.51E+01	4.31E+01	5.36E+01						
Best fit mean:	1.98E+01			3.71E+01			4.06E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00	7.00		3.00	7.00		3.00	7.00							
Average Repair Time (Min Qty, Max Qty)	2.95E+01	2.00E+01		4.97E+01	3.38E+01		5.38E+01	3.66E+01							
CV or beta (Min Qty, Max Qty)	0.41	0.41		0.37	0.37		0.37	0.37							
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		40%	0.50		20%	0.50							

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1033.052a
NISTIR Name Ordinary Concentric Braced Frame w compact braces, Single Diagonal Brace, Brace w < 40 PLF
Description Costing on a per bay basis, braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 56

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual deformation of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Brace has buckled but residual displacement does not exceed two times brace depth. Brace has not fractured. Gusset plate exhibits extensive yielding. Yielding extends well into the members.	Brace has fractured. Gusset plate has torn, possibly completely free of framing. Local buckling of flanges and web of framing members. Bolt fractures in beam-column connections.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.00159	0.01	0.0178		
Data dispersion, β_d :	0.66	0.15	0.43		
Uncertainty, β_u :	0.25	0.25	0.25		
Total Dispersion, β :	0.7	0.3	0.3		

Correlation (Yes / No) NO
Directionality (Yes / No) YES
Quality Ratings
Data Quality Not Rated
Data Relevance Marginal
Documentation Quality average
Rationality Superior
Consequence Functions
Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Replace brace. Gusset plate must be replaced 50% of the time. Heat straightening of deformed beams and columns may be required.

Replace brace. Gusset plate must be replaced 90% of the time. Replacement of portions (deformed flanges, webs) of permanently deformed beams and columns likely required.

Long Lead Time (Yes / No)	NO			NO			NO								
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.39E+04	3.49E+04	3.88E+04	1.69E+04	3.86E+04	4.41E+04	1.77E+04	3.96E+04	4.55E+04						
Best fit mean:	2.92E+04			3.32E+04			3.43E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00			3.00 7.00								
Average Repair Cost (Min Qty, Max Qty)	4.36E+04			4.83E+04			4.95E+04			3.37E+04					
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.32 0.32			0.32 0.32								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.17E+00	2.31E+01	2.57E+01	1.12E+01	2.56E+01	2.92E+01	1.17E+01	2.62E+01	3.01E+01						
Best fit mean:	1.93E+01			2.20E+01			2.27E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00			3.00 7.00								
Average Repair Time (Min Qty, Max Qty)	2.88E+01			3.20E+01			3.28E+01			2.23E+01					
CV or beta (Min Qty, Max Qty)	0.42 0.42			0.41 0.41			0.40 0.40								
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			40% 0.50			20% 0.50								

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1033.052b
NISTIR Name Ordinary Concentric Braced Frame w compact braces, Single Diagonal Brace, Brace w, 41 PLF < w < 99 PLF
Description Costing on a per bay basis, braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 57

Construction Quality:	Not Specified				Quantity Rounding Allow sum by floor or building? Demand Location (floor above)?	Round Qty? YES NO NO
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	EA 1					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	3					
Damage State:	DS1	DS2	DS3			
Type of Damage State:	Sequential	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2,DS3)					
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual deformation of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Brace has buckled but residual displacement does not exceed two times brace depth. Brace has not fractured. Gusset plate exhibits extensive yielding. Yielding extends well into the members.	Brace has fractured. Gusset plate has torn, possibly completely free of framing. Local buckling of flanges and web of framing members. Bolt fractures in beam-column connections.			

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.00159	0.01	0.0178		
Data dispersion, β_d :	0.66	0.15	0.43		
Uncertainty, β_u :	0.25	0.25	0.25		
Total Dispersion, β :	0.7	0.3	0.3		

Correlation (Yes / No) NO
Directionality (Yes / No) YES
Quality Ratings
Data Quality Not Rated
Data Relevance Marginal
Documentation Quality average
Rationality Superior
Consequence Functions
Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Replace brace. Gusset plate must be replaced 50% of the time. Heat straightening of deformed beams and columns may be required.

Replace brace. Gusset plate must be replaced 90% of the time. Replacement of portions (deformed flanges, webs) of permanently deformed beams and columns likely required.

Long Lead Time (Yes / No) NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.39E+04	3.49E+04	3.88E+04	2.12E+04	4.40E+04	5.17E+04	2.40E+04	4.75E+04	5.66E+04						
Best fit mean:	2.92E+04			3.89E+04			4.27E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00			3.00 7.00								
Average Repair Cost (Min Qty, Max Qty)	4.36E+04			5.50E+04			5.94E+04			4.04E+04					
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.31 0.31			0.30 0.30								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.17E+00	2.31E+01	2.57E+01	1.40E+01	2.91E+01	3.42E+01	1.59E+01	3.14E+01	3.74E+01						
Best fit mean:	1.93E+01			2.58E+01			2.82E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00			3.00 7.00								
Average Repair Time (Min Qty, Max Qty)	2.88E+01			3.64E+01			2.48E+01			3.93E+01			2.67E+01		
CV or beta (Min Qty, Max Qty)	0.42 0.42			0.39 0.39			0.39 0.39			0.39 0.39					
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			40% 0.50			20% 0.50								

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1033.052c
NISTIR Name Ordinary Concentric Braced Frame w compact braces, Single Diagonal Brace, Brace w > 100 PLF
Description Costing on a per bay basis, braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 58

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential		Sequential		Sequential
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	<div>Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual deformation of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.</div> <div>Brace has buckled but residual displacement does not exceed two times brace depth. Brace has not fractured. Gusset plate exhibits extensive yielding. Yielding extends well into the members.</div> <div>Brace has fractured. Gusset plate has torn, possibly completely free of framing. Local buckling of flanges and web of framing members. Bolt fractures in beam-column connections.</div>				

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.00159	0.01	0.0178		
Data dispersion, β_d :	0.66	0.15	0.43		
Uncertainty, β_u :	0.25	0.25	0.25		
Total Dispersion, β :	0.7	0.3	0.3		

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Not Rated
Data Relevance Marginal
Documentation Quality average
Rationality Superior

Consequence Functions
Repair Description
Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.
Replace brace. Gusset plate must be replaced 50% of the time. Heat straightening of deformed beams and columns may be required.
Replace brace. Gusset plate must be replaced 90% of the time. Replacement of portions (deformed flanges, webs) of permanently deformed beams and columns likely required.

Long Lead Time (Yes / No)	NO			NO			NO								
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.39E+04	3.49E+04	3.88E+04	2.70E+04	5.12E+04	6.17E+04	3.14E+04	5.67E+04	6.94E+04						
Best fit mean:	2.92E+04			4.66E+04			5.25E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00			3.00 7.00								
Average Repair Cost (Min Qty, Max Qty)	4.36E+04			6.40E+04			7.09E+04			4.82E+04					
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.29 0.29			0.28 0.28								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.17E+00	2.31E+01	2.57E+01	1.78E+01	3.39E+01	4.08E+01	2.08E+01	3.75E+01	4.59E+01						
Best fit mean:	1.93E+01			3.08E+01			3.47E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00			3.00 7.00								
Average Repair Time (Min Qty, Max Qty)	2.88E+01			4.24E+01			4.69E+01			3.19E+01					
CV or beta (Min Qty, Max Qty)	0.42 0.42			0.38 0.38			0.38 0.38								
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable								
Casualty-affected Planar Area (sf) per Normative Unit:	0%			0%			0%								
Serious Injury (Median, Dispersion)	0.00			0.00			0.00								
Loss of Life (Median, Dispersion)	0.00			0.00			0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%			40%			20%								
	0.00			0.50			0.50								

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1033.053a
NISTIR Name Ordinary Concentric Braced Frame w compact braces, X Brace, Brace w < 40 PLF
Description Costing on a per bay basis, braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 59

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual deformation of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Brace has buckled but residual displacement does not exceed two times brace depth. Brace has not fractured. Gusset plate exhibits extensive yielding. Yielding extends well into the members.	Brace has fractured. Gusset plate has torn, possibly completely free of framing. Local buckling of flanges and web of framing members. Bolt fractures in beam-column connections.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.00159	0.01	0.0178		
Data dispersion, β_d :	0.66	0.15	0.43		
Uncertainty, β_u :	0.25	0.25	0.25		
Total Dispersion, β :	0.7	0.3	0.3		

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Not Rated
Data Relevance Marginal
Documentation Quality average
Rationality Superior

Consequence Functions
Repair Description
Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.
Replace brace. Gusset plate must be replaced 50% of the time. Heat straightening of deformed beams and columns may be required.
Replace brace. Gusset plate must be replaced 90% of the time. Replacement of portions (deformed flanges, webs) of permanently deformed beams and columns likely required.

Long Lead Time (Yes / No) NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.52E+04	3.65E+04	4.11E+04	2.04E+04	4.30E+04	5.02E+04	2.16E+04	4.45E+04	5.23E+04						
Best fit mean:	3.09E+04			3.78E+04			3.94E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00			3.00 7.00								
Average Repair Cost (Min Qty, Max Qty)	4.56E+04 0.33 3.10E+04 0.33			5.37E+04 0.31 3.65E+04 0.31			5.56E+04 0.30 3.78E+04 0.30								
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.00E+01	2.41E+01	2.72E+01	1.35E+01	2.85E+01	3.32E+01	1.43E+01	2.94E+01	3.46E+01						
Best fit mean:	2.04E+01			2.50E+01			2.61E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00			3.00 7.00								
Average Repair Time (Min Qty, Max Qty)	3.02E+01 0.41 2.05E+01 0.41			3.56E+01 0.40 2.42E+01 0.40			3.68E+01 0.39 2.50E+01 0.39								
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			40% 0.50			20% 0.50								

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1033.053b
NISTIR Name Ordinary Concentric Braced Frame w compact braces, X Brace, Brace w, 41 PLF < w < 99 PLF
Description Costing on a per bay basis, braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 60

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual deformation of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Brace has buckled but residual displacement does not exceed two times brace depth. Brace has not fractured. Gusset plate exhibits extensive yielding. Yielding extends well into the members.	Brace has fractured. Gusset plate has torn, possibly completely free of framing. Local buckling of flanges and web of framing members. Bolt fractures in beam-column connections.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.00159	0.01	0.0178		
Data dispersion, β_d :	0.66	0.15	0.43		
Uncertainty, β_u :	0.25	0.25	0.25		
Total Dispersion, β :	0.7	0.3	0.3		

Correlation (Yes / No) NO
Directionality (Yes / No) YES
Quality Ratings
Data Quality Not Rated
Data Relevance Marginal
Documentation Quality average
Rationality Superior
Consequence Functions
Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Replace brace. Gusset plate must be replaced 50% of the time. Heat straightening of deformed beams and columns may be required.

Replace brace. Gusset plate must be replaced 90% of the time. Replacement of portions (deformed flanges, webs) of permanently deformed beams and columns likely required.

Long Lead Time (Yes / No)	NO			NO			NO														
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀						
Repair Cost by Damage State:	1.52E+04	3.65E+04	4.11E+04	3.04E+04	5.55E+04	6.77E+04	3.32E+04	5.90E+04	7.26E+04												
Best fit mean:	3.09E+04			5.12E+04			5.49E+04														
Best Fit Distribution:	Normal			Normal			Normal														
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00												
Average Repair Cost (Min Qty, Max Qty)	4.56E+04		3.10E+04	6.93E+04		4.71E+04	7.37E+04		5.01E+04												
CV or beta (Min Qty, Max Qty)	0.33		0.33	0.28		0.28	0.28		0.28												
Quantity Unit:	Each			Each			Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀						
Repair Time by Damage State:	1.00E+01	2.41E+01	2.72E+01	2.01E+01	3.67E+01	4.48E+01	2.19E+01	3.90E+01	4.80E+01												
Best fit mean:	2.04E+01			3.39E+01			3.63E+01														
Best Fit Distribution:	Normal			Normal			Normal														
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00												
Average Repair Time (Min Qty, Max Qty)	3.02E+01		2.05E+01	4.59E+01		3.12E+01	4.88E+01		3.32E+01												
CV or beta (Min Qty, Max Qty)	0.41		0.41	0.38		0.38	0.38		0.38												
Quantity Unit:	Each			Each			Each														
LifeSafety Hazard:																					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00													
Post-event Tagging Flag:	NO			YES			YES														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		40%	0.50		20%	0.50													
Comments:	None																				
Date Created:	Not Given																				
Approved (YES / NO)?	By User																				
Official (YES / NO) ?	By User																				
Author:	Not Given																				
Revisions:	2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.																				

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1033.053c
NISTIR Name Ordinary Concentric Braced Frame w compact braces, X Brace, Brace w > 100 PLF
Description Costing on a per bay basis, braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 61

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Buckling of the brace has begun but does not exceed the depth of the brace. Initial yielding of the gusset has begun. Yielding has initiated in framing at gusset plates but no buckling has occurred. Residual deformation of the brace has occurred but is barely noticeable to the naked eye and does not exceed half the brace depth. Residual drift is slight.	Brace has buckled but residual displacement does not exceed two times brace depth. Brace has not fractured. Gusset plate exhibits extensive yielding. Yielding extends well into the members.	Brace has fractured. Gusset plate has torn, possibly completely free of framing. Local buckling of flanges and web of framing members. Bolt fractures in beam-column connections.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.00159	0.01	0.0178		
Data dispersion, β_d :	0.66	0.15	0.43		
Uncertainty, β_u :	0.25	0.25	0.25		
Total Dispersion, β :	0.7	0.3	0.3		

Correlation (Yes / No) NO
Directionality (Yes / No) YES
Quality Ratings
Data Quality Not Rated
Data Relevance Marginal
Documentation Quality average
Rationality Superior
Consequence Functions
Repair Description

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Replace brace. Gusset plate must be replaced 50% of the time. Heat straightening of deformed beams and columns may be required.

Replace brace. Gusset plate must be replaced 90% of the time. Replacement of portions (deformed flanges, webs) of permanently deformed beams and columns likely required.

Long Lead Time (Yes / No) NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.52E+04	3.65E+04	4.11E+04	4.25E+04	7.07E+04	8.90E+04	4.69E+04	7.62E+04	9.67E+04						
Best fit mean:	3.09E+04			6.74E+04			7.32E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00			3.00 7.00								
Average Repair Cost (Min Qty, Max Qty)	4.56E+04			8.83E+04			9.52E+04			6.47E+04					
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.27 0.27			0.27 0.27								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.00E+01	2.41E+01	2.72E+01	2.81E+01	4.68E+01	5.89E+01	3.10E+01	5.04E+01	6.40E+01						
Best fit mean:	2.04E+01			4.46E+01			4.85E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00			3.00 7.00								
Average Repair Time (Min Qty, Max Qty)	3.02E+01			5.85E+01			6.30E+01			4.28E+01					
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.37 0.37			0.36 0.36								
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			40% 0.50			20% 0.50								

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification
NISTIR Name
Description

B1033.061a
Ordinary Concentric Braced Frame, braces design to ductile slenderness limits, Chevron Brace, Brace w < 40 PLF
Costing on a per bay basis, equivalent to AISC OCBF criteria. Braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 62

Construction Quality:	Not Specified				Quantity Rounding	Round Qty?	YES
Seismic Installation Conditions:	Not Specified				Allow sum by floor or building?	NO	
Fragility Unit of Measure:	EA 1				Demand Location (floor above?)	NO	
Demand Parameter (unit):	Story Drift Ratio		Unit less				
Number of Damage States:	3						
Damage State:	DS1		DS2		DS3		
Type of Damage State:	Sequential		Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)						
Descriptions	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.		Buckling of brace in excess of 2 time brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.		Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas. Nearly total loss of lateral resistance.		
Illustrations	<div></div>						
	none		none		none		
Damage State Probability:	1.00		1.00		1.00		
Fragility Parameters							
Median Demand, θ :	0.00159		0.01		0.01776		
Data dispersion, β_d :	0.65		0.15		0.4		
Uncertainty, β_u :	0.25		0.25		0.25		
Total Dispersion, β :	0.7		0.3		0.3		
Correlation (Yes / No)	NO						
Directionality (Yes / No)	YES						
Quality Ratings							
Data Quality	Average						
Data Relevance	Average						
Documentation Quality	Average						
Rationality	Average						
Consequence Functions							
Repair Description	Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.						
	Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.						
	Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed						

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.49E+04	3.61E+04	4.05E+04	1.84E+04	4.05E+04	4.66E+04	1.98E+04	4.22E+04	4.90E+04						
Best fit mean:	3.05E+04			3.51E+04			3.70E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00						
Average Repair Cost (Min Qty, Max Qty)	4.51E+04		3.07E+04	5.06E+04		3.44E+04	5.27E+04		3.58E+04						
CV or beta (Min Qty, Max Qty)	0.33		0.33	0.31		0.31	0.31		0.31						
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.83E+00	2.39E+01	2.68E+01	1.22E+01	2.68E+01	3.08E+01	1.31E+01	2.79E+01	3.24E+01						
Best fit mean:	2.02E+01			2.32E+01			2.45E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00						
Average Repair Time (Min Qty, Max Qty)	2.98E+01		2.03E+01	3.35E+01		2.28E+01	3.49E+01		2.37E+01						
CV or beta (Min Qty, Max Qty)	0.41		0.41	0.40		0.40	0.40		0.40						
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00						
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00						
Post-event Tagging Flag:	YES			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	60%		0.50	40%		0.50	20%		0.50						
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.														
	Root Cost Multiplier: 1														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification
NISTIR Name
Description

B1033.061b
Ordinary Concentric Braced Frame, braces design to ductile slenderness limits, Chevron Brace, Brace 41 PLF < w < 99 PLF
Costing on a per bay basis, equivalent to AISC OCBF criteria. Braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 63

Construction Quality:	Not Specified				Quantity Rounding Round Qty? YES Allow sum by floor or building? NO Demand Location (floor above)? No
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 time brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas. Nearly total loss of lateral resistance.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.00159	0.01	0.01776		
Data dispersion, β_d :	0.65	0.15	0.4		
Uncertainty, β_u :	0.25	0.25	0.25		
Total Dispersion, β :	0.7	0.3	0.3		

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Average
Data Relevance Average
Documentation Quality Average
Rationality Average

Consequence Functions
Repair Description
Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.
Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.
Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No) NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.49E+04	3.61E+04	4.05E+04	2.58E+04	4.98E+04	5.98E+04	2.86E+04	5.33E+04	6.47E+04						
Best fit mean:	3.05E+04			4.51E+04			4.88E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00			3.00 7.00								
Average Repair Cost (Min Qty, Max Qty)	4.51E+04 0.33 0.33			6.23E+04 0.29 0.29			6.67E+04 0.29 0.29								
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.83E+00	2.39E+01	2.68E+01	1.70E+01	3.30E+01	3.95E+01	1.89E+01	3.53E+01	4.28E+01						
Best fit mean:	2.02E+01			2.99E+01			3.23E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00			3.00 7.00								
Average Repair Time (Min Qty, Max Qty)	2.98E+01 0.41 0.41			4.12E+01 0.39 0.39			4.41E+01 0.38 0.38								
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	YES			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	60% 0.50			40% 0.50			20% 0.50								

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.
Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification
NISTIR Name
Description

B1033.061c
Ordinary Concentric Braced Frame, braces design to ductile slenderness limits, Chevron Brace, Brace w > 100 PLF
Costing on a per bay basis, equivalent to AISC OCBF criteria. Braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 64

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 time brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas. Nearly total loss of lateral resistance.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	0.00159	0.01	0.01776	
Data dispersion, β_d :	0.65	0.15	0.4	
Uncertainty, β_u :	0.25	0.25	0.25	
Total Dispersion, β :	0.7	0.3	0.3	
Correlation (Yes / No)	NO			
Directionality (Yes / No)	YES			
Quality Ratings				
Data Quality	Average			
Data Relevance	Average			
Documentation Quality	Average			
Rationality	Average			
Consequence Functions				
Repair Description				

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.49E+04	3.61E+04	4.05E+04	3.47E+04	6.10E+04	7.54E+04	3.87E+04	6.60E+04	8.24E+04						
Best fit mean:	3.05E+04			5.70E+04			6.23E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00			3.00 7.00								
Average Repair Cost (Min Qty, Max Qty)	4.51E+04 3.07E+04			7.62E+04 5.18E+04			8.25E+04 5.61E+04								
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.28 0.28			0.27 0.27								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.83E+00	2.39E+01	2.68E+01	2.29E+01	4.04E+01	4.99E+01	2.56E+01	4.37E+01	5.45E+01						
Best fit mean:	2.02E+01			3.77E+01			4.13E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00			3.00 7.00								
Average Repair Time (Min Qty, Max Qty)	2.98E+01 2.03E+01			5.04E+01 3.43E+01			5.46E+01 3.71E+01								
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.37 0.37			0.37 0.37								
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	YES			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	60% 0.50			40% 0.50			20% 0.50								

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification
NISTIR Name
Description

B1033.062a
Ordinary Concentric Braced Frame, braces design to ductile slenderness limits, Single Diagonal Brace, Brace w < 40 PLF
Costing on a per bay basis, equivalent to AISC OCBF criteria. Braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 65

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 time brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas. Nearly total loss of lateral resistance.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	0.00159	0.01	0.01776	
Data dispersion, β_d :	0.65	0.15	0.4	
Uncertainty, β_u :	0.25	0.25	0.25	
Total Dispersion, β :	0.7	0.3	0.3	
Correlation (Yes / No)	NO			
Directionality (Yes / No)	YES			
Quality Ratings				
Data Quality	Average			
Data Relevance	Average			
Documentation Quality	Average			
Rationality	Average			
Consequence Functions				
Repair Description				

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.43E+04	3.53E+04	3.94E+04	1.73E+04	3.91E+04	4.47E+04	1.79E+04	3.99E+04	4.59E+04						
Best fit mean:	2.96E+04			3.37E+04			3.48E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00						
Average Repair Cost (Min Qty, Max Qty)	4.42E+04		3.00E+04	4.89E+04		3.32E+04	4.99E+04		3.39E+04						
CV or beta (Min Qty, Max Qty)	0.33		0.33	0.32		0.32	0.32		0.32						
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.44E+00	2.34E+01	2.60E+01	1.14E+01	2.59E+01	2.96E+01	1.18E+01	2.64E+01	3.03E+01						
Best fit mean:	1.96E+01			2.23E+01			2.29E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00						
Average Repair Time (Min Qty, Max Qty)	2.92E+01		1.99E+01	3.23E+01		2.20E+01	3.30E+01		2.25E+01						
CV or beta (Min Qty, Max Qty)	0.41		0.41	0.40		0.40	0.40		0.40						
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable								
Casualty-affected Planar Area (sf) per Normative Unit:															
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	YES			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	60%	0.50		40%	0.50		20%	0.50							
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability. 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1033.062b
NISTIR Name Ordinary Concentric Braced Frame, braces design to ductile slenderness limits, Single Diagonal Brace, Brace 41 PLF < w < 99 PLF
Description Costing on a per bay basis, equivalent to AISC OCBF criteria. Braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 66

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 time brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas. Nearly total loss of lateral resistance.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.00159	0.01	0.01776		
Data dispersion, β_d :	0.65	0.15	0.4		
Uncertainty, β_u :	0.25	0.25	0.25		
Total Dispersion, β :	0.7	0.3	0.3		

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Average
Data Relevance Average
Documentation Quality Average
Rationality Average

Consequence Functions
Repair Description
Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.
Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.
Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No) NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.43E+04	3.53E+04	3.94E+04	2.17E+04	4.46E+04	5.25E+04	2.45E+04	4.81E+04	5.74E+04						
Best fit mean:	2.96E+04			3.96E+04			4.33E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00						
Average Repair Cost (Min Qty, Max Qty)	4.42E+04		3.00E+04	5.58E+04		3.79E+04	6.01E+04		4.09E+04						
CV or beta (Min Qty, Max Qty)	0.33		0.33	0.30		0.30	0.30		0.30						
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.44E+00	2.34E+01	2.60E+01	1.43E+01	2.95E+01	3.47E+01	1.62E+01	3.18E+01	3.80E+01						
Best fit mean:	1.96E+01			2.62E+01			2.87E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00						
Average Repair Time (Min Qty, Max Qty)	2.92E+01		1.99E+01	3.69E+01		2.51E+01	3.98E+01		2.71E+01						
CV or beta (Min Qty, Max Qty)	0.41		0.41	0.39		0.39	0.39		0.39						
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable								
Casualty-affected Planar Area (sf) per Normative Unit:															
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	YES			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	60%	0.50		40%	0.50		20%	0.50							

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR ClassificationB1033.062c

NISTIR NameOrdinary Concentric Braced Frame, braces design to ductile slenderness limits, Single Diagonal Brace, Brace w > 100 PLF

DescriptionCosting on a per bay basis, equivalent to AISC OCBF criteria. Braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 67

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 time brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas. Nearly total loss of lateral resistance.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.00159	0.01	0.01776		
Data dispersion, β_d :	0.65	0.15	0.4		
Uncertainty, β_u :	0.25	0.25	0.25		
Total Dispersion, β :	0.7	0.3	0.3		

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Average
Data Relevance Average
Documentation Quality Average
Rationality Average

Consequence Functions
Repair Description
Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.
Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.
Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No) NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.43E+04	3.53E+04	3.94E+04	2.75E+04	5.18E+04	6.25E+04	3.19E+04	5.73E+04	7.02E+04						
Best fit mean:	2.96E+04			4.72E+04			5.31E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00						
Average Repair Cost (Min Qty, Max Qty)	4.42E+04		3.00E+04	6.48E+04		4.40E+04	7.16E+04		4.87E+04						
CV or beta (Min Qty, Max Qty)	0.33		0.33	0.29		0.29	0.28		0.28						
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.44E+00	2.34E+01	2.60E+01	1.82E+01	3.43E+01	4.13E+01	2.11E+01	3.79E+01	4.64E+01						
Best fit mean:	1.96E+01			3.13E+01			3.51E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00						
Average Repair Time (Min Qty, Max Qty)	2.92E+01		1.99E+01	4.29E+01		2.91E+01	4.74E+01		3.22E+01						
CV or beta (Min Qty, Max Qty)	0.41		0.41	0.38		0.38	0.38		0.38						
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable								
Casualty-affected Planar Area (sf) per Normative Unit:															
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	YES			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	60%	0.50		40%	0.50		20%	0.50							

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification
NISTIR Name
Description

B1033.063a
Ordinary Concentric Braced Frame, braces design to ductile slenderness limits, X Brace, Brace w < 40 PLF
Costing on a per bay basis, equivalent to AISC OCBF criteria. Braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 68

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 time brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas. Nearly total loss of lateral resistance.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	0.00159	0.01	0.01776	
Data dispersion, β_d :	0.65	0.15	0.4	
Uncertainty, β_u :	0.25	0.25	0.25	
Total Dispersion, β :	0.7	0.3	0.3	
Correlation (Yes / No)	NO			
Directionality (Yes / No)	YES			
Quality Ratings				
Data Quality	Average			
Data Relevance	Average			
Documentation Quality	Average			
Rationality	Average			
Consequence Functions				
Repair Description				

Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.56E+04	3.69E+04	4.17E+04	2.10E+04	4.37E+04	5.13E+04	2.22E+04	4.52E+04	5.34E+04						
Best fit mean:	3.14E+04			3.87E+04			4.03E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00			3.00 7.00								
Average Repair Cost (Min Qty, Max Qty)	4.62E+04 3.14E+04			5.47E+04 3.72E+04			5.66E+04 3.85E+04								
CV or beta (Min Qty, Max Qty)	0.32 0.32			0.31 0.31			0.30 0.30								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.03E+01	2.44E+01	2.76E+01	1.39E+01	2.89E+01	3.39E+01	1.47E+01	2.99E+01	3.53E+01						
Best fit mean:	2.08E+01			2.56E+01			2.66E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00			3.00 7.00								
Average Repair Time (Min Qty, Max Qty)	3.05E+01 2.08E+01			3.62E+01 2.46E+01			3.74E+01 2.54E+01								
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.40 0.40			0.39 0.39								
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	YES			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	60% 0.50			40% 0.50			20% 0.50								

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1033.063b

Ordinary Concentric Braced Frame, braces design to ductile slenderness limits, X Brace, Brace 41 PLF < w < 99 PLF

Costing on a per bay basis, equivalent to AISC OCBF criteria. Braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 69

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 time brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas. Nearly total loss of lateral resistance.		

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.00159	0.01	0.01776		
Data dispersion, β_d :	0.65	0.15	0.4		
Uncertainty, β_u :	0.25	0.25	0.25		
Total Dispersion, β :	0.7	0.3	0.3		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Average				
Data Relevance	Average				
Documentation Quality	Average				
Rationality	Average				
Consequence Functions					
Repair Description	Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.				

Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.

Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)	NO			NO			NO														
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀						
Repair Cost by Damage State:	1.56E+04	3.69E+04	4.17E+04	3.16E+04	5.70E+04	6.98E+04	3.44E+04	6.05E+04	7.47E+04												
Best fit mean:	3.14E+04			5.28E+04			5.65E+04														
Best Fit Distribution:	Normal			Normal			Normal														
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00												
Average Repair Cost (Min Qty, Max Qty)	4.62E+04		3.14E+04	7.12E+04		4.84E+04	7.56E+04		5.14E+04												
CV or beta (Min Qty, Max Qty)	0.32		0.32	0.28		0.28	0.28		0.28												
Quantity Unit:	Each			Each			Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀						
Repair Time by Damage State:	1.03E+01	2.44E+01	2.76E+01	2.09E+01	3.77E+01	4.62E+01	2.27E+01	4.00E+01	4.94E+01												
Best fit mean:	2.08E+01			3.49E+01			3.74E+01														
Best Fit Distribution:	Normal			Normal			Normal														
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00												
Average Repair Time (Min Qty, Max Qty)	3.05E+01		2.08E+01	4.71E+01		3.20E+01	5.00E+01		3.40E+01												
CV or beta (Min Qty, Max Qty)	0.41		0.41	0.38		0.38	0.37		0.37												
Quantity Unit:	Each			Each			Each														
LifeSafety Hazard:																					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00													
Post-event Tagging Flag:	YES			YES			YES														
Unsafe Placard Trigger (Median, Dispersion)	60%	0.50		40%	0.50		20%	0.50													
Comments:	None																				
Date Created:	Not Given																				
Approved (YES / NO)?	By User																				
Official (YES / NO) ?	By User																				
Author:	Not Given																				
Revisions:	2011-08-24 DS3 beta changed from 0.5 to 0.30 to avoid negative probability.																				

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR ClassificationB1033.063c

NISTIR NameOrdinary Concentric Braced Frame, braces design to ductile slenderness limits, X Brace, Brace w > 100 PLF

DescriptionCosting on a per bay basis, equivalent to AISC OCBF criteria. Braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 70

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Buckling of brace in excess of the brace depth. Initiation of yielding and out-of-plane deformation of the gusset. Initiation of cracking of welds of gusset. Initiation of yielding in beams and columns adjacent to gusset.	Buckling of brace in excess of 2 time brace depth. Yielding and out-of-plane deformation of gusset. Cracking and tearing of welds and gussets adjacent to welds but crack length is less than critical for fracture. Significant yielding and local buckling in beams and columns adjacent to gusset.	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas. Nearly total loss of lateral resistance.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.00159	0.01	0.01776		
Data dispersion, β_d :	0.65	0.15	0.4		
Uncertainty, β_u :	0.25	0.25	0.25		
Total Dispersion, β :	0.7	0.3	0.3		

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Average
Data Relevance Average
Documentation Quality Average
Rationality Average

Consequence Functions
Repair Description
Brace damage is largely aesthetic. Heat straightening may be desirable but replacement would be for aesthetic reasons. Gusset has minor loss of strength and stiffness and straightening or repair may be desirable aesthetic reasons.
Brace has lost significant axial capacity, and replacement of braces is likely required. The gusset plate may have significant deformation and replacement may also be needed. Local beam and column yielding has occurred and straightening may be desirable for aesthetic reasons.
Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed

Long Lead Time (Yes / No)	NO			NO			NO								
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.56E+04	3.69E+04	4.17E+04	4.37E+04	7.22E+04	9.11E+04	4.81E+04	7.77E+04	9.88E+04						
Best fit mean:	3.14E+04			6.90E+04			7.48E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00						
Average Repair Cost (Min Qty, Max Qty)	4.62E+04		3.14E+04	9.02E+04		6.13E+04	9.71E+04		6.60E+04						
CV or beta (Min Qty, Max Qty)	0.32		0.32	0.27		0.27	0.26		0.26						
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.03E+01	2.44E+01	2.76E+01	2.89E+01	4.78E+01	6.03E+01	3.18E+01	5.14E+01	6.54E+01						
Best fit mean:	2.08E+01			4.56E+01			4.95E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00						
Average Repair Time (Min Qty, Max Qty)	3.05E+01		2.08E+01	5.97E+01		4.06E+01	6.42E+01		4.37E+01						
CV or beta (Min Qty, Max Qty)	0.41		0.41	0.37		0.37	0.36		0.36						
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	YES			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	60%	0.50		40%	0.50		20%	0.50							

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1033.071a

Braced frame, design for factored loads, no additional seismic detailing, Chevron Brace, Brace w < 40 PLF
Costing on a per bay basis, equivalent to current AISC R=3. Braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 71

Construction Quality:	Not Specified			<div>Quantity Rounding</div> <div>Round Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Story Drift Ratio	Unit less		
Number of Damage States:	1			
Damage State:	DS1			
Type of Damage State:	Sequential			
DS Hierarchy	Seq(DS1)			
Descriptions	Fracture of brace or gusset. Buckling of gusset. Substantial loss of lateral resistance.			

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none				
Damage State Probability:	1.00				

Fragility Parameters					
Median Demand, θ :	0.0042				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	0.25				
Total Dispersion, β :	0.25				
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Average				
Documentation Quality	Average				
Rationality	Superior				
Consequence Functions					
Repair Description	Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.				

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.84E+04	4.05E+04	4.66E+04												
Best fit mean:	3.51E+04														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00												
Average Repair Cost (Min Qty, Max Qty)	5.06E+04		3.44E+04												
CV or beta (Min Qty, Max Qty)	0.31		0.31												
Quantity Unit:	Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.22E+01	2.68E+01	3.08E+01												
Best fit mean:	2.32E+01														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00												
Average Repair Time (Min Qty, Max Qty)	3.35E+01		2.28E+01												
CV or beta (Min Qty, Max Qty)	0.40		0.40												
Quantity Unit:	Each														
LifeSafety Hazard:	NO														
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	YES														
Unsafe Placard Trigger (Median, Dispersion)	20%	0.50													
Comments:	currently shown in DS3... Please confirm if two additional damage state performances should be added or if only one cost damage state should be included.														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1033.071b

Braced frame, design for factored loads, no additional seismic detailing, Chevron Brace, 41 PLF < w < 99 PLF
Costing on a per bay basis, equivalent to current AISC R=3. Braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 72

Construction Quality:	Not Specified		<div>Quantity Rounding</div> <div>Round Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>	
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Story Drift Ratio	Unit less		
Number of Damage States:	1	1		
Damage State:	DS1			
Type of Damage State:	Sequential			
DS Hierarchy	Seq(DS1)			
Descriptions	Fracture of brace or gusset. Buckling of gusset. Substantial loss of lateral resistance.			

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none				
Damage State Probability:	1.00				

Fragility Parameters					
Median Demand, θ :	0.0042				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	0.25				
Total Dispersion, β :	0.25				

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Not Rated
Data Relevance Average
Documentation Quality Average
Rationality Superior

Consequence Functions
Repair Description
Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.58E+04	4.98E+04	5.98E+04												
Best fit mean:	4.51E+04														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00												
Average Repair Cost (Min Qty, Max Qty)	6.23E+04		4.24E+04												
CV or beta (Min Qty, Max Qty)	0.29		0.29												
Quantity Unit:	Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.70E+01	3.30E+01	3.95E+01												
Best fit mean:	2.99E+01														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00												
Average Repair Time (Min Qty, Max Qty)	4.12E+01		2.80E+01												
CV or beta (Min Qty, Max Qty)	0.39		0.39												
Quantity Unit:	Each														
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	YES														
Unsafe Placard Trigger (Median, Dispersion)	20%	0.50													

Comments: currently shown in DS3... Please confirm if two additional damage state performances should be added or if only one cost damage state should be included.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1033.071c
Braced frame, design for factored loads, no additional seismic detailing, Chevron Brace, Brace w > 100 PLF
Costing on a per bay basis, equivalent to current AISC R=3. Braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 73

Construction Quality:	Not Specified		<div>Quantity Rounding</div> <div>Round Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>	
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Story Drift Ratio	Unit less		
Number of Damage States:	1	1		
Damage State:	DS1			
Type of Damage State:	Sequential			
DS Hierarchy	Seq(DS1)			
Descriptions	Fracture of brace or gusset. Buckling of gusset. Substantial loss of lateral resistance.			

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none				
Damage State Probability:	1.00				

Fragility Parameters					
Median Demand, θ :	0.0042				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	0.25				
Total Dispersion, β :	0.25				

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Not Rated
Data Relevance Average
Documentation Quality Average
Rationality Superior

Consequence Functions
Repair Description
Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.47E+04	6.10E+04	7.54E+04												
Best fit mean:	5.70E+04														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00												
Average Repair Cost (Min Qty, Max Qty)	7.62E+04		5.18E+04												
CV or beta (Min Qty, Max Qty)	0.28		0.28												
Quantity Unit:	Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.29E+01	4.04E+01	4.99E+01												
Best fit mean:	3.77E+01														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00												
Average Repair Time (Min Qty, Max Qty)	5.04E+01		3.43E+01												
CV or beta (Min Qty, Max Qty)	0.37		0.37												
Quantity Unit:	Each														
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	YES														
Unsafe Placard Trigger (Median, Dispersion)	20%	0.50													

Comments: currently shown in DS3... Please confirm if two additional damage state performances should be added or if only one cost damage state should be included.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1033.072a

Braced frame, design for factored loads, no additional seismic detailing, Single Diagonal Brace, Brace w < 40 PLF
Costing on a per bay basis, equivalent to current AISC R=3. Braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 74

Construction Quality:	Not Specified				Quantity Rounding		Round Qty?	YES
Seismic Installation Conditions:	Not Specified				Allow sum by floor or building?		NO	
Fragility Unit of Measure:	EA 1				Demand Location (floor above?)		No	
Demand Parameter (unit):	Story Drift Ratio		Unit less					
Number of Damage States:	1		1					
Damage State:	DS1							
Type of Damage State:	Sequential							
DS Hierarchy	Seq(DS1)							
Descriptions	Fracture of brace or gusset. Buckling of gusset. Substantial loss of lateral resistance.							

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none				
Damage State Probability:	1.00				

Fragility Parameters					
Median Demand, θ :	0.0042				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	0.25				
Total Dispersion, β :	0.25				

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Not Rated
Data Relevance Average
Documentation Quality Average
Rationality Superior

Consequence Functions
Repair Description
Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.73E+04	3.91E+04	4.47E+04												
Best fit mean:	3.37E+04														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00												
Average Repair Cost (Min Qty, Max Qty)	4.89E+04		3.32E+04												
CV or beta (Min Qty, Max Qty)	0.32		0.32												
Quantity Unit:	Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.14E+01	2.59E+01	2.96E+01												
Best fit mean:	2.23E+01														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00												
Average Repair Time (Min Qty, Max Qty)	3.23E+01		2.20E+01												
CV or beta (Min Qty, Max Qty)	0.40		0.40												
Quantity Unit:	Each														
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	YES														
Unsafe Placard Trigger (Median, Dispersion)	20%	0.50													

Comments: currently shown in DS3... Please confirm if two additional damage state performances should be added or if only one cost damage state should be included.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1033.072b

Braced frame, design for factored loads, no additional seismic detailing, Single Diagonal Brace, 41 PLF < w < 99 PLF
Costing on a per bay basis, equivalent to current AISC R=3. Braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 75

Construction Quality:	Not Specified		<div>Quantity Rounding</div> <div>Round Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>	
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Story Drift Ratio	Unit less		
Number of Damage States:	1	1		
Damage State:	DS1			
Type of Damage State:	Sequential			
DS Hierarchy	Seq(DS1)			
Descriptions	Fracture of brace or gusset. Buckling of gusset. Substantial loss of lateral resistance.			

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none				
Damage State Probability:	1.00				

Fragility Parameters					
Median Demand, θ :	0.0042				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	0.25				
Total Dispersion, β :	0.25				

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Not Rated
Data Relevance Average
Documentation Quality Average
Rationality Superior

Consequence Functions
Repair Description
Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.17E+04	4.46E+04	5.25E+04												
Best fit mean:	3.96E+04														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00												
Average Repair Cost (Min Qty, Max Qty)	5.58E+04		3.79E+04												
CV or beta (Min Qty, Max Qty)	0.30		0.30												
Quantity Unit:	Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.43E+01	2.95E+01	3.47E+01												
Best fit mean:	2.62E+01														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00												
Average Repair Time (Min Qty, Max Qty)	3.69E+01		2.51E+01												
CV or beta (Min Qty, Max Qty)	0.39		0.39												
Quantity Unit:	Each														
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	YES														
Unsafe Placard Trigger (Median, Dispersion)	20%	0.50													

Comments: currently shown in DS3... Please confirm if two additional damage state performances should be added or if only one cost damage state should be included.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1033.072c

Braced frame, design for factored loads, no additional seismic detailing, Single Diagonal Brace, Brace w > 100 PLF
Costing on a per bay basis, equivalent to current AISC R=3. Braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 76

Construction Quality:	Not Specified			<div>Quantity Rounding</div> <div>Round Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Story Drift Ratio	Unit less		
Number of Damage States:	1			
Damage State:	DS1			
Type of Damage State:	Sequential			
DS Hierarchy	Seq(DS1)			
Descriptions	Fracture of brace or gusset. Buckling of gusset. Substantial loss of lateral resistance.			

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none				
Damage State Probability:	1.00				

Fragility Parameters					
Median Demand, θ :	0.0042				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	0.25				
Total Dispersion, β :	0.25				

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Not Rated
Data Relevance Average
Documentation Quality Average
Rationality Superior

Consequence Functions
Repair Description
Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.75E+04	5.18E+04	6.25E+04												
Best fit mean:	4.72E+04														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00												
Average Repair Cost (Min Qty, Max Qty)	6.48E+04		4.40E+04												
CV or beta (Min Qty, Max Qty)	0.29		0.29												
Quantity Unit:	Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.82E+01	3.43E+01	4.13E+01												
Best fit mean:	3.13E+01														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00												
Average Repair Time (Min Qty, Max Qty)	4.29E+01		2.91E+01												
CV or beta (Min Qty, Max Qty)	0.38		0.38												
Quantity Unit:	Each														
LifeSafety Hazard:	NO														
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	YES														
Unsafe Placard Trigger (Median, Dispersion)	20%	0.50													

Comments: currently shown in DS3... Please confirm if two additional damage state performances should be added or if only one cost damage state should be included.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1033.073a

Braced frame, design for factored loads, no additional seismic detailing, X Brace, Brace w < 40 PLF
Costing on a per bay basis, equivalent to current AISC R=3. Braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 77

Construction Quality:	Not Specified		<div>Quantity Rounding</div> <div>Round Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>	
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Story Drift Ratio	Unit less		
Number of Damage States:	1	1		
Damage State:	DS1			
Type of Damage State:	Sequential			
DS Hierarchy	Seq(DS1)			
Descriptions	Fracture of brace or gusset. Buckling of gusset. Substantial loss of lateral resistance.			

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none				
Damage State Probability:	1.00				

Fragility Parameters					
Median Demand, θ :	0.0042				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	0.25				
Total Dispersion, β :	0.25				

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Not Rated
Data Relevance Average
Documentation Quality Average
Rationality Superior

Consequence Functions
Repair Description
Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.10E+04	4.37E+04	5.13E+04												
Best fit mean:	3.87E+04														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00												
Average Repair Cost (Min Qty, Max Qty)	5.47E+04		3.72E+04												
CV or beta (Min Qty, Max Qty)	0.31		0.31												
Quantity Unit:	Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.39E+01	2.89E+01	3.39E+01												
Best fit mean:	2.56E+01														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00												
Average Repair Time (Min Qty, Max Qty)	3.62E+01		2.46E+01												
CV or beta (Min Qty, Max Qty)	0.40		0.40												
Quantity Unit:	Each														
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	YES														
Unsafe Placard Trigger (Median, Dispersion)	20%	0.50													

Comments: currently shown in DS3... Please confirm if two additional damage state performances should be added or if only one cost damage state should be included.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1033.073b

Braced frame, design for factored loads, no additional seismic detailing, X Brace, Brace 41 PLF < w < 99 PLF
Costing on a per bay basis, equivalent to current AISC R=3. Braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 78

Construction Quality:	Not Specified				Quantity Rounding		Round Qty?	YES
Seismic Installation Conditions:	Not Specified				Allow sum by floor or building?		NO	
Fragility Unit of Measure:	EA 1				Demand Location (floor above?)		No	
Demand Parameter (unit):	Story Drift Ratio		Unit less					
Number of Damage States:	1		1					
Damage State:	DS1							
Type of Damage State:	Sequential							
DS Hierarchy	Seq(DS1)							
Descriptions	Fracture of brace or gusset. Buckling of gusset. Substantial loss of lateral resistance.							

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none				
Damage State Probability:	1.00				

Fragility Parameters					
Median Demand, θ :	0.0042				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	0.25				
Total Dispersion, β :	0.25				

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Not Rated
Data Relevance Average
Documentation Quality Average
Rationality Superior

Consequence Functions
Repair Description
Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.16E+04	5.70E+04	6.98E+04												
Best fit mean:	5.28E+04														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00												
Average Repair Cost (Min Qty, Max Qty)	7.12E+04		4.84E+04												
CV or beta (Min Qty, Max Qty)	0.28		0.28												
Quantity Unit:	Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.09E+01	3.77E+01	4.62E+01												
Best fit mean:	3.49E+01														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00												
Average Repair Time (Min Qty, Max Qty)	4.71E+01		3.20E+01												
CV or beta (Min Qty, Max Qty)	0.38		0.38												
Quantity Unit:	Each														
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	YES														
Unsafe Placard Trigger (Median, Dispersion)	20%	0.50													

Comments: currently shown in DS3... Please confirm if two additional damage state performances should be added or if only one cost damage state should be included.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1033.073c

Braced frame, design for factored loads, no additional seismic detailing, X Brace, Brace w > 100 PLF
Costing on a per bay basis, equivalent to current AISC R=3. Braces may be HSS, WF, or Angle. Costing does not include fireproofing removal or reapplication cost.

Line 79

Construction Quality:	Not Specified		<div>Quantity Rounding</div> <div>Round Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>	
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Story Drift Ratio	Unit less		
Number of Damage States:	1	1		
Damage State:	DS1			
Type of Damage State:	Sequential			
DS Hierarchy	Seq(DS1)			
Descriptions	Fracture of brace or gusset. Buckling of gusset. Substantial loss of lateral resistance.			

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none				
Damage State Probability:	1.00				

Fragility Parameters					
Median Demand, θ :	0.0042				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	0.25				
Total Dispersion, β :	0.25				

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Not Rated
Data Relevance Average
Documentation Quality Average
Rationality Superior

Consequence Functions
Repair Description
Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	4.37E+04	7.22E+04	9.11E+04												
Best fit mean:	6.90E+04														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00												
Average Repair Cost (Min Qty, Max Qty)	9.02E+04		6.13E+04												
CV or beta (Min Qty, Max Qty)	0.27		0.27												
Quantity Unit:	Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.89E+01	4.78E+01	6.03E+01												
Best fit mean:	4.56E+01														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00												
Average Repair Time (Min Qty, Max Qty)	5.97E+01		4.06E+01												
CV or beta (Min Qty, Max Qty)	0.37		0.37												
Quantity Unit:	Each														
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	YES														
Unsafe Placard Trigger (Median, Dispersion)	20%	0.50													

Comments: currently shown in DS3... Please confirm if two additional damage state performances should be added or if only one cost damage state should be included.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1033.101a
NISTIR Name Steel Buckling Restrained Brace (BRB), Chevron Brace, Weight of brace < 40 plf.
Description None

Line 80

Construction Quality:	Not Specified				Quantity Rounding		Round Qty?	YES
Seismic Installation Conditions:	Not Specified				Allow sum by floor or building?		NO	
Fragility Unit of Measure:	EA 1				Demand Location (floor above?)		No	
Demand Parameter (unit):	Story Drift Ratio		Unit less					
Number of Damage States:	1							
Damage State:	DS1							
Type of Damage State:	Sequential							
DS Hierarchy	Seq(DS1)							
Descriptions	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas. Severe loss of lateral resistance.							

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none				

Damage State Probability:		1.00			
Fragility Parameters					
Median Demand, θ :	0.02				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	0.4				
Correlation (Yes / No)		NO			
Directionality (Yes / No)		YES			
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description					
		Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.			

Long Lead Time (Yes / No) NO

Repair Costs:				P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:				2.14E+04	4.43E+04	5.21E+04									
Best fit mean:				3.92E+04											
Best Fit Distribution:				Normal											
Quantity Plateau (Min Qty, Max Qty)				5.00		20.00									
Average Repair Cost (Min Qty, Max Qty)				5.76E+04		3.54E+04									
CV or beta (Min Qty, Max Qty)				0.31		0.31									
Quantity Unit:				Each											
Repair Time:				P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:				1.41E+01	2.93E+01	3.45E+01									
Best fit mean:				2.60E+01											
Best Fit Distribution:				Normal											
Quantity Plateau (Min Qty, Max Qty)				5.00		20.00									
Average Repair Time (Min Qty, Max Qty)				3.81E+01		2.35E+01									
CV or beta (Min Qty, Max Qty)				0.39		0.39									
Quantity Unit:				Each											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)				NO											
Casualty-affected Planar Area (sf) per Normative Unit:				Not Applicable											
Serious Injury (Median, Dispersion)				0%	0.00										
Loss of Life (Median, Dispersion)				0%	0.00										
Post-event Tagging Flag:				NO											
Unsafe Placard Trigger (Median, Dispersion)				0%	0.00										
Comments:				None											
Date Created:				Not Given											
Approved (YES / NO)?				By User											
Official (YES / NO) ?				By User											
Author:				John Wallace											
Revisions:				2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight. Median demand established from PEER TBI project.											
				Root Cost Multiplier: 1											

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1033.101b
NISTIR Name Steel Buckling Restrained Brace (BRB), Chevron brace, Weight of brace > 41 plf and < 99 plf.
Description None

Line 81

Construction Quality:	Not Specified				Quantity Rounding		Round Qty?	YES
Seismic Installation Conditions:	Not Specified				Allow sum by floor or building?		NO	
Fragility Unit of Measure:	EA 1				Demand Location (floor above?)		No	
Demand Parameter (unit):	Story Drift Ratio		Unit less					
Number of Damage States:	1							
Damage State:	DS1							
Type of Damage State:	Sequential							
DS Hierarchy	Seq(DS1)							
Descriptions	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas. Severe loss of lateral resistance.							

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none				
Damage State Probability:	1.00				

Fragility Parameters					
Median Demand, θ :	0.02				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	0.4				
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.				

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.24E+04	5.81E+04	7.13E+04												
Best fit mean:	5.39E+04														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00												
Average Repair Cost (Min Qty, Max Qty)	7.55E+04		4.65E+04												
CV or beta (Min Qty, Max Qty)	0.28		0.28												
Quantity Unit:	Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.14E+01	3.84E+01	4.72E+01												
Best fit mean:	3.57E+01														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00												
Average Repair Time (Min Qty, Max Qty)	5.00E+01		3.07E+01												
CV or beta (Min Qty, Max Qty)	0.38		0.38												
Quantity Unit:	Each														
LifeSafety Hazard:	NO														
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	John Wallace														
Revisions:	2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight. Median demand established from PEER TBI project.														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1033.101c
NISTIR Name Steel Buckling Restrained Brace (BRB), Chevron Brace, Weight of brace > 100 plf.
Description None

Line 82

Construction Quality:	Not Specified				Quantity Rounding		Round Qty?	YES
Seismic Installation Conditions:	Not Specified				Allow sum by floor or building?		NO	
Fragility Unit of Measure:	EA 1				Demand Location (floor above?)		No	
Demand Parameter (unit):	Story Drift Ratio		Unit less					
Number of Damage States:	1							
Damage State:	DS1							
Type of Damage State:	Sequential							
DS Hierarchy	Seq(DS1)							
Descriptions	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas. Severe loss of lateral resistance.							

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none				

Damage State Probability:		1.00			
Fragility Parameters					
Median Demand, θ :	0.02				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	0.4				
Correlation (Yes / No)		NO			
Directionality (Yes / No)		YES			
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description					
		Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.			

Long Lead Time (Yes / No) NO

Repair Costs:				P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:				4.62E+04	7.52E+04	9.53E+04									
Best fit mean:				7.22E+04											
Best Fit Distribution:				Normal											
Quantity Plateau (Min Qty, Max Qty)				5.00		20.00									
Average Repair Cost (Min Qty, Max Qty)				9.78E+04		6.02E+04									
CV or beta (Min Qty, Max Qty)				0.27		0.27									
Quantity Unit:				Each											
Repair Time:				P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:				3.05E+01	4.98E+01	6.30E+01									
Best fit mean:				4.78E+01											
Best Fit Distribution:				Normal											
Quantity Plateau (Min Qty, Max Qty)				5.00		20.00									
Average Repair Time (Min Qty, Max Qty)				6.47E+01		3.98E+01									
CV or beta (Min Qty, Max Qty)				0.36		0.36									
Quantity Unit:				Each											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)				NO											
Casualty-affected Planar Area (sf) per Normative Unit:				Not Applicable											
Serious Injury (Median, Dispersion)				0%	0.00										
Loss of Life (Median, Dispersion)				0%	0.00										
Post-event Tagging Flag:				NO											
Unsafe Placard Trigger (Median, Dispersion)				0%	0.00										
Comments:				None											
Date Created:				Not Given											
Approved (YES / NO)?				By User											
Official (YES / NO)?				By User											
Author:				John Wallace											
Revisions:				2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight. Median demand established from PEER TBI project.											
				Root Cost Multiplier: 1											

Root Cost Multiplier: 1

Comments:	None		
Date Created:	Not Given	Root Cost Multiplier:	1
Approved (YES / NO)?	By User		
Official (YES / NO) ?	By User		
Author:	John Wallace		
Revisions:	2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight. Median demand established from PEER TBI project.		

FEMA P-58 Fragility Specification

NISTIR Classification B1033.111b
NISTIR Name Steel Buckling Restrained Brace (BRB), Single Diagonal brace, Weight of brace > 41 plf and < 99 plf.
Description None

Line 84

Construction Quality:	Not Specified				Quantity Rounding		Round Qty?	YES
Seismic Installation Conditions:	Not Specified				Allow sum by floor or building?		NO	
Fragility Unit of Measure:	EA 1				Demand Location (floor above?)		No	
Demand Parameter (unit):	Story Drift Ratio		Unit less					
Number of Damage States:	1							
Damage State:	DS1							
Type of Damage State:	Sequential							
DS Hierarchy	Seq(DS1)							
Descriptions	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas. Severe loss of lateral resistance.							

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none				

Damage State Probability:		1.00			
Fragility Parameters					
Median Demand, θ :	0.02				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	0.4				
Correlation (Yes / No)		NO			
Directionality (Yes / No)		YES			
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.				

Long Lead Time (Yes / No) NO

Repair Costs:				P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:				2.66E+04	5.07E+04	6.10E+04									
Best fit mean:				4.61E+04											
Best Fit Distribution:				Normal											
Quantity Plateau (Min Qty, Max Qty)				5.00		20.00									
Average Repair Cost (Min Qty, Max Qty)				6.59E+04		4.06E+04									
CV or beta (Min Qty, Max Qty)				0.29		0.29									
Quantity Unit:				Each											
Repair Time:				P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:				1.76E+01	3.36E+01	4.03E+01									
Best fit mean:				3.05E+01											
Best Fit Distribution:				Normal											
Quantity Plateau (Min Qty, Max Qty)				5.00		20.00									
Average Repair Time (Min Qty, Max Qty)				4.36E+01		2.68E+01									
CV or beta (Min Qty, Max Qty)				0.38		0.38									
Quantity Unit:				Each											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)				NO											
Casualty-affected Planar Area (sf) per Normative Unit:				Not Applicable											
Serious Injury (Median, Dispersion)				0%	0.00										
Loss of Life (Median, Dispersion)				0%	0.00										
Post-event Tagging Flag:				NO											
Unsafe Placard Trigger (Median, Dispersion)				0%	0.00										
Comments:				None											
Date Created:				Not Given											
Approved (YES / NO)?				By User											
Official (YES / NO) ?				By User											
Author:				John Wallace											
Revisions:				2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight. Median demand established from PEER TBI project.											
				Root Cost Multiplier: 1											

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1033.111c
NISTIR Name Steel Buckling Restrained Brace (BRB), Single Diagonal Brace, Weight of brace > 100 plf.
Description None

Line 85

Construction Quality:	Not Specified				Quantity Rounding		Round Qty?	YES
Seismic Installation Conditions:	Not Specified				Allow sum by floor or building?		NO	
Fragility Unit of Measure:	EA 1				Demand Location (floor above?)		No	
Demand Parameter (unit):	Story Drift Ratio		Unit less					
Number of Damage States:	1							
Damage State:	DS1							
Type of Damage State:	Sequential							
DS Hierarchy	Seq(DS1)							
Descriptions	Fracture of brace or gusset. Buckling of gusset. Severe yielding of beams and columns adjacent to the gusset with possibility of local buckling and cracking in the yielded areas. Severe loss of lateral resistance.							

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none				

Damage State Probability:		1.00			
Fragility Parameters					
Median Demand, θ :	0.02				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	0.4				
Correlation (Yes / No)		NO			
Directionality (Yes / No)		YES			
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description					
		Brace and gusset are severely damaged with significant loss in stiffness and resistance, and both likely require replacement. Yielding and local buckling of beams and columns may be repaired by heat straightening, stiffeners or reinforcement, if there is no cracking or tearing. If cracking or tearing has initiated more substantial repair is needed.			

Long Lead Time (Yes / No) NO

Repair Costs:				P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:				3.54E+04	6.18E+04	7.66E+04									
Best fit mean:				5.79E+04											
Best Fit Distribution:				Normal											
Quantity Plateau (Min Qty, Max Qty)				5.00		20.00									
Average Repair Cost (Min Qty, Max Qty)				8.04E+04		4.95E+04									
CV or beta (Min Qty, Max Qty)				0.28		0.28									
Quantity Unit:				Each											
Repair Time:				P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:				2.34E+01	4.09E+01	5.07E+01									
Best fit mean:				3.83E+01											
Best Fit Distribution:				Normal											
Quantity Plateau (Min Qty, Max Qty)				5.00		20.00									
Average Repair Time (Min Qty, Max Qty)				5.32E+01		3.27E+01									
CV or beta (Min Qty, Max Qty)				0.37		0.37									
Quantity Unit:				Each											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)				NO											
Casualty-affected Planar Area (sf) per Normative Unit:				Not Applicable											
Serious Injury (Median, Dispersion)				0%	0.00										
Loss of Life (Median, Dispersion)				0%	0.00										
Post-event Tagging Flag:				NO											
Unsafe Placard Trigger (Median, Dispersion)				0%	0.00										
Comments:				None											
Date Created:				Not Given											
Approved (YES / NO)?				By User											
Official (YES / NO) ?				By User											
Author:				John Wallace											
Revisions:				2016-08-17 time consequence adjusted to avoid decreasing consequence with increasing member weight. Median demand established from PEER TBI project.											

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1035.001
NISTIR Name Post-Northridge RBS connection with welded web, beam one side of column only, beam depth <= W27
Description Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 86

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Local beam flange and web buckling.	DS1 plus lateral-torsional distortion of beam in hinge region.	Low-cycle fatigue fracture in buckled region of RBS.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.03	0.04	0.05		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	0.3	0.3	0.3		
Total Dispersion, β :	0.3	0.3	0.3		

Correlation (Yes / No) NO
Directionality (Yes / No) YES
Quality Ratings
Data Quality Superior
Data Relevance Average
Documentation Quality Superior
Rationality Superior
Consequence Functions
Repair Description The likely repair state is heat straightening of the buckled flanges and web. Repair and replace partitions at connection. Repair will necessitate removal and replacement of distorted and/or fractured portion of beam. Repair and replace partitions at connection. Repair will necessitate removal and replacement of distorted and/or fractured portion of beam. Repair and replace partitions at connection.

Long Lead Time (Yes / No) NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	8.10E+03	1.74E+04	2.26E+04	1.41E+04	2.93E+04	3.44E+04	1.41E+04	2.93E+04	3.44E+04						
Best fit mean:	1.60E+04			2.59E+04			2.59E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00						
Average Repair Cost (Min Qty, Max Qty)	2.18E+04		1.48E+04	3.66E+04		2.49E+04	3.66E+04		2.49E+04						
CV or beta (Min Qty, Max Qty)	0.35		0.35	0.31		0.31	0.31		0.31						
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	4.76E+00	1.02E+01	1.33E+01	8.29E+00	1.72E+01	2.02E+01	8.29E+00	1.72E+01	2.02E+01						
Best fit mean:	1.02E+01			1.72E+01			1.72E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00						
Average Repair Time (Min Qty, Max Qty)	1.28E+01		8.70E+00	2.15E+01		1.47E+01	2.15E+01		1.47E+01						
CV or beta (Min Qty, Max Qty)	0.43		0.43	0.39		0.39	0.39		0.39						
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		50%	0.50		50%	0.50							
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Greg Deierlein														
Revisions:	None														
	Root Cost Multiplier: 1														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1035.002
Post-Northridge RBS connection with welded web, beam one side of column only, beam depth >= W30
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 87

Construction Quality:	Not Specified			<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Story Drift Ratio	Unit less		
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Local beam flange and web buckling.	DS1 plus lateral-torsional distortion of beam in hinge region.	Low-cycle fatigue fracture in buckled region of RBS.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	0.03	0.04	0.05	
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified	
Uncertainty, β_u :	0.3	0.3	0.3	
Total Dispersion, β :	0.3	0.3	0.3	

Correlation (Yes / No) NO
Directionality (Yes / No) YES
Quality Ratings
Data Quality Superior
Data Relevance Average
Documentation Quality Superior
Rationality Superior
Consequence Functions

Repair Description
The likely repair state is heat straightening of the beam. Repair and replace partitions at connection.
Repair will necessitate removal and replacement of distorted and/or fractured portion of beam. Repair and replace partitions at connection.
Repair will necessitate removal and replacement of distorted and/or fractured portion of beam. Repair and replace partitions at connection.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	9.10E+03	1.84E+04	2.36E+04	1.61E+04	3.24E+04	3.68E+04	1.61E+04	3.24E+04	3.68E+04						
Best fit mean:	1.70E+04			2.84E+04			2.84E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00						
Average Repair Cost (Min Qty, Max Qty)	2.30E+04		1.56E+04	4.05E+04		2.75E+04	4.05E+04		2.75E+04						
CV or beta (Min Qty, Max Qty)	0.33		0.33	0.28		0.28	0.28		0.28						
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.35E+00	1.08E+01	1.39E+01	9.47E+00	1.91E+01	2.16E+01	9.47E+00	1.91E+01	2.16E+01						
Best fit mean:	1.08E+01			1.91E+01			1.91E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00						
Average Repair Time (Min Qty, Max Qty)	1.35E+01		9.20E+00	2.38E+01		1.62E+01	2.38E+01		1.62E+01						
CV or beta (Min Qty, Max Qty)	0.42		0.42	0.38		0.38	0.38		0.38						
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable								
Casualty-affected Planar Area (sf) per Normative Unit:	0%			0%			0%								
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00						
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00						
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	50%		0.50	50%		0.50						

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1035.011
NISTIR Name Post-Northridge RBS connection with welded web, beams both sides of column, beam depth <= W27
Description Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 88

Construction Quality:	Not Specified			<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Story Drift Ratio	Unit less		
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential		Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Local beam flange and web buckling.	DS1 plus lateral-torsional distortion of beam in hinge region.	Low-cycle fatigue fracture in buckled region of RBS.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.03	0.04	0.05		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	0.3	0.3	0.3		
Total Dispersion, β :	0.3	0.3	0.3		

Correlation (Yes / No) NO
Directionality (Yes / No) YES
Quality Ratings
Data Quality Superior
Data Relevance Average
Documentation Quality Superior
Rationality Superior
Consequence Functions
Repair Description The likely repair state is heat straightening of the buckled flanges and web. Repair and replace partitions at connection. Repair will necessitate removal and replacement of distorted and/or fractured portion of beam. Repair and replace partitions at connection. Repair will necessitate removal and replacement of distorted and/or fractured portion of beam. Repair and replace partitions at connection.

Long Lead Time (Yes / No)				NO			NO			NO														
Repair Costs:				P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀						
Repair Cost by Damage State:				1.37E+04	3.00E+04	3.60E+04	2.77E+04	5.23E+04	6.10E+04	2.77E+04	5.23E+04	6.10E+04												
Best fit mean:				2.66E+04			4.70E+04			4.70E+04														
Best Fit Distribution:				Normal			Normal			Normal														
Quantity Plateau (Min Qty, Max Qty)				3.00		7.00	3.00		7.00	3.00		7.00												
Average Repair Cost (Min Qty, Max Qty)				3.75E+04		2.55E+04	6.54E+04		4.45E+04	6.54E+04		4.45E+04												
CV or beta (Min Qty, Max Qty)				0.33		0.33	0.28		0.28	0.28		0.28												
Quantity Unit:				Each			Each			Each														
Repair Time:				P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀						
Repair Time by Damage State:				8.06E+00	1.76E+01	2.12E+01	1.63E+01	3.08E+01	3.59E+01	1.63E+01	3.08E+01	3.59E+01												
Best fit mean:				1.76E+01			3.08E+01			3.08E+01														
Best Fit Distribution:				Normal			Normal			Normal														
Quantity Plateau (Min Qty, Max Qty)				3.00		7.00	3.00		7.00	3.00		7.00												
Average Repair Time (Min Qty, Max Qty)				2.21E+01		1.50E+01	3.85E+01		2.61E+01	3.85E+01		2.61E+01												
CV or beta (Min Qty, Max Qty)				0.41		0.41	0.37		0.37	0.37		0.37												
Quantity Unit:				Each			Each			Each														
LifeSafety Hazard:																								
Potential non-collapse casualties? (Yes / No)				NO			NO			NO														
Casualty-affected Planar Area (sf) per Normative Unit:				Not Applicable			Not Applicable			Not Applicable														
Serious Injury (Median, Dispersion)				0%	0.00		0%	0.00		0%	0.00													
Loss of Life (Median, Dispersion)				0%	0.00		0%	0.00		0%	0.00													
Post-event Tagging Flag:				NO			YES			YES														
Unsafe Placard Trigger (Median, Dispersion)				0%	0.00		50%	0.50		50%	0.50													
Comments:				None																				
Date Created:				Not Given																				
Approved (YES / NO)?				By User																				
Official (YES / NO) ?				By User																				
Author:				Greg Deierlein																				
Revisions:				None																				
										Root Cost Multiplier:		1												

FEMA P-58 Fragility Specification

NISTIR Classification B1035.012
NISTIR Name Post-Northridge RBS connection with welded web, beams both sides of column, beam depth >= W30
Description Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 89

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Local beam flange and web buckling.	DS1 plus lateral-torsional distortion of beam in hinge region.	Low-cycle fatigue fracture in buckled region of RBS.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.03	0.04	0.05		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	0.3	0.3	0.3		
Total Dispersion, β :	0.3	0.3	0.3		

Correlation (Yes / No) NO
Directionality (Yes / No) YES
Quality Ratings
Data Quality Superior
Data Relevance Average
Documentation Quality Superior
Rationality Superior
Consequence Functions
Repair Description The likely repair state is heat straightening of the buckled flanges and web. Repair and replace partitions at connection. Repair will necessitate removal and replacement of distorted and/or fractured portion of beam. Repair and replace partitions at connection. Repair will necessitate removal and replacement of distorted and/or fractured portion of beam. Repair and replace partitions at connection.

Long Lead Time (Yes / No)	NO			NO			NO								
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.57E+04	3.20E+04	3.85E+04	3.27E+04	5.85E+04	6.60E+04	3.27E+04	5.85E+04	6.60E+04						
Best fit mean:	2.87E+04			5.24E+04			5.24E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00						
Average Repair Cost (Min Qty, Max Qty)	4.00E+04		2.72E+04	7.31E+04		4.97E+04	7.31E+04		4.97E+04						
CV or beta (Min Qty, Max Qty)	0.31		0.31	0.25		0.25	0.25		0.25						
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.24E+00	1.88E+01	2.26E+01	1.92E+01	3.44E+01	3.88E+01	1.92E+01	3.44E+01	3.88E+01						
Best fit mean:	1.88E+01			3.44E+01			3.44E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00						
Average Repair Time (Min Qty, Max Qty)	2.35E+01		1.60E+01	4.30E+01		2.93E+01	4.30E+01		2.93E+01						
CV or beta (Min Qty, Max Qty)	0.40		0.40	0.35		0.35	0.35		0.35						
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		50%	0.50		50%	0.50							
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Greg Deierlein														
Revisions:	None														
	Root Cost Multiplier: 1														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR ClassificationB1035.021

NISTIR NamePost-Northridge welded steel moment connection other than RBS, beam one side, beam depth <= W27

DescriptionCosting is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 90

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Local beam flange and web buckling.	DS1 plus lateral-torsional distortion of beam in hinge region.	Low-cycle fatigue fracture in buckled region of RBS.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.03	0.04	0.05		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	0.3	0.3	0.3		
Total Dispersion, β :	0.3	0.3	0.3		

Correlation (Yes / No)NO

Directionality (Yes / No)YES

Quality Ratings

Data QualitySuperior

Data RelevanceAverage

Documentation QualitySuperior

RationalitySuperior

Consequence Functions

Repair DescriptionThe likely repair state is heat straightening of the beam. Repair and replace partitions at connection.

Repair will necessitate removal and replacement of distorted and/or fractured portion of beam. Repair and replace partitions at connection.

Repair will necessitate removal and replacement of distorted and/or fractured portion of beam. Repair and replace partitions at connection.

Long Lead Time (Yes / No)				NO			NO			NO									
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	
Repair Cost by Damage State:	8.10E+03	1.74E+04	2.26E+04	1.41E+04	2.93E+04	3.44E+04	1.41E+04	2.93E+04	3.44E+04										
Best fit mean:	1.60E+04			2.59E+04			2.59E+04												
Best Fit Distribution:	Normal			Normal			Normal												
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00	3.00		7.00							
Average Repair Cost (Min Qty, Max Qty)	2.09E+04		1.39E+04	3.52E+04		2.34E+04	3.52E+04		2.34E+04										
CV or beta (Min Qty, Max Qty)	0.35		0.35	0.31		0.31	0.31		0.31										
Quantity Unit:	Each			Each			Each												
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	
Repair Time by Damage State:	4.76E+00	1.02E+01	1.33E+01	8.29E+00	1.72E+01	2.02E+01	8.29E+00	1.72E+01	2.02E+01										
Best fit mean:	1.02E+01			1.72E+01			1.72E+01												
Best Fit Distribution:	Normal			Normal			Normal												
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00										
Average Repair Time (Min Qty, Max Qty)	1.23E+01		8.19E+00	2.07E+01		1.38E+01	2.07E+01		1.38E+01										
CV or beta (Min Qty, Max Qty)	0.43		0.43	0.39		0.39	0.39		0.39										
Quantity Unit:	Each			Each			Each												
LifeSafety Hazard:																			
Potential non-collapse casualties? (Yes / No)	NO			NO			NO												
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable												
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00											
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00											
Post-event Tagging Flag:	NO			YES			YES												
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		50%	0.50		50%	0.50											
Comments:	None																		
Date Created:	Not Given																		
Approved (YES / NO)?	By User																		
Official (YES / NO) ?	By User																		
Author:	Greg Deierlein																		
Revisions:	None																		
										Root Cost Multiplier:		1							

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1035.022
NISTIR Name Post-Northridge welded steel moment connection other than RBS, beam one side, beam depth >= W30
Description Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 91

Construction Quality:	Not Specified			<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Story Drift Ratio	Unit less		
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Local beam flange and web buckling.	DS1 plus lateral-torsional distortion of beam in hinge region.	Low-cycle fatigue fracture in buckled region of RBS.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.03	0.04	0.05		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	0.3	0.3	0.3		
Total Dispersion, β :	0.3	0.3	0.3		

Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Superior				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	The likely repair state is heat straightening of the beam. Repair and replace partitions at connection.	Repair will necessitate removal and replacement of distorted and/or fractured portion of beam. Repair and replace partitions at connection.	Repair will necessitate removal and replacement of distorted and/or fractured portion of beam. Repair and replace partitions at connection.		

Long Lead Time (Yes / No)				NO			NO			NO														
Repair Costs:				P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀						
Repair Cost by Damage State:				9.10E+03	1.84E+04	2.36E+04	1.61E+04	3.24E+04	3.68E+04	1.61E+04	3.24E+04	3.68E+04												
Best fit mean:				1.70E+04			2.84E+04			2.84E+04														
Best Fit Distribution:				Normal			Normal			Normal														
Quantity Plateau (Min Qty, Max Qty)				3.00		7.00	3.00		7.00	3.00		7.00												
Average Repair Cost (Min Qty, Max Qty)				2.21E+04		1.47E+04	3.89E+04		2.59E+04	3.89E+04		2.59E+04												
CV or beta (Min Qty, Max Qty)				0.33		0.33	0.28		0.28	0.28		0.28												
Quantity Unit:				Each			Each			Each														
Repair Time:				P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀						
Repair Time by Damage State:				5.35E+00	1.08E+01	1.39E+01	9.47E+00	1.91E+01	2.16E+01	9.47E+00	1.91E+01	2.16E+01												
Best fit mean:				1.08E+01			1.91E+01			1.91E+01														
Best Fit Distribution:				Normal			Normal			Normal														
Quantity Plateau (Min Qty, Max Qty)				3.00		7.00	3.00		7.00	3.00		7.00												
Average Repair Time (Min Qty, Max Qty)				1.30E+01		8.66E+00	2.29E+01		1.52E+01	2.29E+01		1.52E+01												
CV or beta (Min Qty, Max Qty)				0.42		0.42	0.38		0.38	0.38		0.38												
Quantity Unit:				Each			Each			Each														
LifeSafety Hazard:																								
Potential non-collapse casualties? (Yes / No)				NO			NO			NO														
Casualty-affected Planar Area (sf) per Normative Unit:				Not Applicable			Not Applicable			Not Applicable														
Serious Injury (Median, Dispersion)				0%	0.00		0%	0.00		0%	0.00													
Loss of Life (Median, Dispersion)				0%	0.00		0%	0.00		0%	0.00													
Post-event Tagging Flag:				NO			YES			YES														
Unsafe Placard Trigger (Median, Dispersion)				0%	0.00		50%	0.50		50%	0.50													
Comments:				None																				
Date Created:				Not Given																				
Approved (YES / NO)?				By User																				
Official (YES / NO) ?				By User																				
Author:				Greg Deierlein																				
Revisions:				None																				
													Root Cost Multiplier:		1									

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1035.031
NISTIR Name Post-Northridge welded steel moment connection other than RBS, beams both sides, beam depth <= W27
Description Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 92

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Local beam flange and web buckling.	DS1 plus lateral-torsional distortion of beam in hinge region.	Low-cycle fatigue fracture in buckled region of RBS.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.03	0.04	0.05		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	0.3	0.3	0.3		
Total Dispersion, β :	0.3	0.3	0.3		

Correlation (Yes / No) NO
Directionality (Yes / No) YES
Quality Ratings
Data Quality Superior
Data Relevance Average
Documentation Quality Superior
Rationality Superior
Consequence Functions
Repair Description The likely repair state is heat straightening of the beam. Repair and replace partitions at connection. Repair will necessitate removal and replacement of distorted and/or fractured portion of beam. Repair and replace partitions at connection. Repair will necessitate removal and replacement of distorted and/or fractured portion of beam. Repair and replace partitions at connection.

Long Lead Time (Yes / No)				NO			NO			NO														
Repair Costs:				P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀						
Repair Cost by Damage State:				1.47E+04	3.50E+04	4.15E+04	2.77E+04	5.23E+04	6.10E+04	2.77E+04	5.23E+04	6.10E+04												
Best fit mean:				3.04E+04			4.70E+04			4.70E+04														
Best Fit Distribution:				Normal			Normal			Normal														
Quantity Plateau (Min Qty, Max Qty)				3.00		7.00	3.00		7.00	3.00		7.00												
Average Repair Cost (Min Qty, Max Qty)				4.20E+04		2.80E+04	6.28E+04		4.18E+04	6.28E+04		4.18E+04												
CV or beta (Min Qty, Max Qty)				0.34		0.34	0.28		0.28	0.28		0.28												
Quantity Unit:				Each			Each			Each														
Repair Time:				P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀						
Repair Time by Damage State:				8.65E+00	2.06E+01	2.44E+01	1.63E+01	3.08E+01	3.59E+01	1.63E+01	3.08E+01	3.59E+01												
Best fit mean:				2.06E+01			3.08E+01			3.08E+01														
Best Fit Distribution:				Normal			Normal			Normal														
Quantity Plateau (Min Qty, Max Qty)				3.00		7.00	3.00		7.00	3.00		7.00												
Average Repair Time (Min Qty, Max Qty)				2.47E+01		1.65E+01	3.69E+01		2.46E+01	3.69E+01		2.46E+01												
CV or beta (Min Qty, Max Qty)				0.43		0.43	0.37		0.37	0.37		0.37												
Quantity Unit:				Each			Each			Each														
LifeSafety Hazard:																								
Potential non-collapse casualties? (Yes / No)				NO			NO			NO														
Casualty-affected Planar Area (sf) per Normative Unit:				Not Applicable			Not Applicable			Not Applicable														
Serious Injury (Median, Dispersion)				0%	0.00		0%	0.00		0%	0.00													
Loss of Life (Median, Dispersion)				0%	0.00		0%	0.00		0%	0.00													
Post-event Tagging Flag:				NO			YES			YES														
Unsafe Placard Trigger (Median, Dispersion)				0%	0.00		50%	0.50		50%	0.50													
Comments:				None																				
Date Created:				Not Given																				
Approved (YES / NO)?				By User																				
Official (YES / NO) ?				By User																				
Author:				Greg Deierlein																				
Revisions:				None																				
										Root Cost Multiplier:		1												

FEMA P-58 Fragility Specification

NISTIR ClassificationB1035.032

NISTIR NamePost-Northridge welded steel moment connection other than RBS, beams both sides, beam depth >= W30

DescriptionCosting is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 93

Construction Quality:	Not Specified			<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Story Drift Ratio	Unit less		
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Local beam flange and web buckling.	DS1 plus lateral-torsional distortion of beam in hinge region.	Low-cycle fatigue fracture in buckled region of RBS.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.03	0.04	0.05		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	0.3	0.3	0.3		
Total Dispersion, β :	0.3	0.3	0.3		

Correlation (Yes / No)NO

Directionality (Yes / No)YES

Quality Ratings

Data QualitySuperior

Data RelevanceAverage

Documentation QualitySuperior

RationalitySuperior

Consequence Functions

Repair DescriptionThe likely repair state is heat straightening of the beam. Repair and replace partitions at connection.

Repair will necessitate removal and replacement of distorted and/or fractured portion of beam. Repair and replace partitions at connection.

Repair will necessitate removal and replacement of distorted and/or fractured portion of beam. Repair and replace partitions at connection.

Long Lead Time (Yes / No)			NO			NO			NO								
Repair Costs:																	
Repair Cost by Damage State:																	
Best fit mean:																	
Best Fit Distribution:																	
Quantity Plateau (Min Qty, Max Qty)																	
Average Repair Cost (Min Qty, Max Qty)																	
CV or beta (Min Qty, Max Qty)																	
Quantity Unit:																	
Repair Time:																	
Repair Time by Damage State:																	
Best fit mean:																	
Best Fit Distribution:																	
Quantity Plateau (Min Qty, Max Qty)																	
Average Repair Time (Min Qty, Max Qty)																	
CV or beta (Min Qty, Max Qty)																	
Quantity Unit:																	
LifeSafety Hazard:																	
Potential non-collapse casualties? (Yes / No)																	
Casualty-affected Planar Area (sf) per Normative Unit:																	
Serious Injury (Median, Dispersion)																	
Loss of Life (Median, Dispersion)																	
Post-event Tagging Flag:																	
Unsafe Placard Trigger (Median, Dispersion)																	
Comments:																	
Date Created:																	
Approved (YES / NO)?																	
Official (YES / NO) ?																	
Author:																	
Revisions:																	
None																	
Not Given																	
By User																	
By User																	
Greg Deierlein																	
None																	
Root Cost Multiplier: 1																	

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

B1035.041

NISTIR Name

Pre-Northridge WUF-B beam-column joint, beam one side of column, beam depth <= W27

Description

Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 94

Construction Quality: Not Specified

Seismic Installation Conditions: Not Specified

Fragility Unit of Measure: EA 1



Demand Parameter (unit): Story Drift Ratio Unit less

Number of Damage States: 5

Damage State:	DS1	DS2	DS3	DS4	DS5
Type of Damage State:	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive	Sequential
DS Hierarchy	Seq(MutEx(DS1,DS2),MutEx(DS3,DS4),DS5)				
Descriptions	Fracture of lower beam flange weld and failure of web bolts (shear tab connection), with fractures confined to the weld region.	Similar to DS1, except that fracture propagates into column flanges.	Fracture of upper beam flange weld, without DS1 type damage. Fracture is confined to beam flange region.	Similar to DS3, except that fracture propagates into column flanges.	Fracture initiating at weld access hole and propagating through beam flange, possibly accompanied by local buckling deformations of web and flange.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Illustrations

				
B1035.041-DS1-1.JPG	B1035.041-DS2-1.JPG	none	none	none
0.75	0.25	0.75	0.25	1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :	0.017	0.017	0.025	0.025	0.03
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified	Not Specified	Not Specified
Uncertainty, β_u :	0.4	0.4	0.4	0.4	0.4
Total Dispersion, β :	0.4	0.4	0.4	0.4	0.4

Correlation (Yes / No)

NO

Directionality (Yes / No)

YES

Quality Ratings

Data Quality

Average

Data Relevance

Average

Documentation Quality

Superior

Rationality

Superior

Consequence Functions

Repair Description

Repair will typically require gouging out and re-welding of the beam flange weld, repair of shear tab, and replacing shear bolts. Repair and replace partitions at connection.

In addition to column measures for DS1, repairs to column will be necessary. Cover plate, patch, or replace damaged column flange at connection.

Repairs will be similar to those required for DS1, except that access to weld will likely require removal and replacement of a portion of the floor slab above the weld.

In addition to column measures for DS3, repairs to column will be necessary that will involve replacing a portion of the column flange.

Repair is similar to that for DS1 except that a portion of the beam web and flange may need to be heat straightened or replaced.

Long Lead Time (Yes / No)

NO

NO

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	6.54E+03	1.21E+04	1.73E+04	7.54E+03	1.36E+04	1.98E+04	1.10E+04	1.71E+04	2.53E+04	1.11E+04	1.76E+04	2.84E+04	9.04E+03	1.46E+04	2.18E+04
Best fit mean:	1.20E+04			1.36E+04			1.69E+04			1.77E+04			1.43E+04		
Best Fit Distribution:	Normal			Normal			LogNormal			LogNormal			LogNormal		
Quantity Plateau (Min Qty, Max Qty)	5.00		30.00	5.00		30.00	5.00		30.00	5.00		30.00	5.00		30.00
Average Repair Cost (Min Qty, Max Qty)	1.45E+04		9.65E+03	1.63E+04		1.08E+04	1.75E+04		1.16E+04	2.11E+04		1.41E+04	1.75E+04		1.16E+04
CV or beta (Min Qty, Max Qty)	0.35		0.35	0.35		0.35	0.32		0.32	0.37		0.37	0.34		0.34
Quantity Unit:	Each			Each			Each			Each			Each		
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.85E+00	7.09E+00	1.02E+01	4.44E+00	7.98E+00	1.17E+01	6.49E+00	1.00E+01	1.49E+01	6.52E+00	1.04E+01	1.67E+01	5.32E+00	8.56E+00	1.28E+01
Best fit mean:	7.09E+00			7.98E+00			1.00E+01			1.04E+01			8.56E+00		
Best Fit Distribution:	Normal			Normal			LogNormal			LogNormal			LogNormal		
Quantity Plateau (Min Qty, Max Qty)	5.00		30.00	5.00		30.00	5.00		30.00	5.00		30.00	5.00		30.00
Average Repair Time (Min Qty, Max Qty)	8.51E+00		5.68E+00	9.57E+00		6.38E+00	1.17E+01		8.32E+00	1.24E+01		8.28E+00	1.03E+01		6.85E+00
CV or beta (Min Qty, Max Qty)	0.43		0.43	0.43		0.43	0.41		0.41	0.45		0.45	0.42		0.42
Quantity Unit:	Each			Each			Each			Each			Each		
LifeSafety Hazard:	NO			NO			NO			NO			NO		
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable			Not Applicable			Not Applicable		
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable			Not Applicable		
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00		0%	0.00	
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00		0%	0.00	
Post-event Tagging Flag:	YES			YES			YES			YES			YES		
Unsafe Placard Trigger (Median, Dispersion)	50%	0.50		50%	0.50		50%	0.50		50%	0.50		50%	0.50	

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Greg Deierlein

Revisions:

None

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1035.042

Pre-Northridge WUF-B beam-column joint, beam one side of column, beam depth >= W30
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 95



Construction Quality: Not Specified
Seismic Installation Conditions: Not Specified

Fragility Unit of Measure:	EA 1
Demand Parameter (unit):	Story Drift Ratio Unit less
Number of Damage States:	5

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Damage State:	DS1	DS2	DS3	DS4	DS5
Type of Damage State:	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive	Sequential
DS Hierarchy	Seq(MutEx(DS1,DS2),MutEx(DS3,DS4),DS5)				
Descriptions	Fracture of lower beam flange weld and failure of web bolts (shear tab connection), with fractures confined to the weld region.	Similar to DS1, except that fracture propagates into column flanges.	Fracture of upper beam flange weld, without DS1 type damage. Fracture is confined to beam flange region.	Similar to DS3, except that fracture propagates into column flanges.	Fracture initiating at weld access hole and propagating through beam flange, possibly accompanied by local buckling deformations of web and flange.

Illustrations

				
B1035.041-DS1-1.JPG	B1035.041-DS2-1.JPG	none	none	none
0.75	0.25	0.75	0.25	1.00

Damage State Probability:	0.75	0.25	0.75	0.25	1.00
Fragility Parameters					
Median Demand, θ :	0.017	0.017	0.025	0.025	0.03
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified	Not Specified	Not Specified
Uncertainty, β_u :	0.4	0.4	0.4	0.4	0.4
Total Dispersion, β :	0.4	0.4	0.4	0.4	0.4

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Average
Data Relevance Average
Documentation Quality Superior
Rationality Superior

Consequence Functions
Repair Description
Repair will typically require gouging out and re-welding of the beam flange weld, repair of shear tab, and replacing shear bolts. Repair and replace partitions at connection.
In addition to column measures for DS1, repairs to column will be necessary. Cover plate, patch, or replace damaged column flange at connection.
Repairs will be similar to those required for DS1, except that access to weld will likely require removal and replacement of a portion of the floor slab above the weld.
In addition to column measures for DS3, repairs to column will be necessary that will involve replacing a portion of the column flange.
In addition to that for DS1 except that a portion of the beam web and flange may need to be heat straightened or replaced.

Long Lead Time (Yes / No)	NO			NO			NO			NO			NO																	
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀															
Repair Cost by Damage State:	6.54E+03	1.26E+04	1.78E+04	7.54E+03	1.46E+04	2.08E+04	9.54E+03	1.71E+04	2.63E+04	1.11E+04	1.76E+04	2.84E+04	9.04E+03	1.46E+04	2.18E+04															
Best fit mean:	1.23E+04 Normal			1.43E+04 Normal			1.76E+04 Normal			1.77E+04 LogNormal			1.43E+04 LogNormal																	
Best Fit Distribution:																														
Quantity Plateau (Min Qty, Max Qty)	5.00 30.00			5.00 30.00			5.00 30.00			5.00 30.00			5.00 30.00																	
Average Repair Cost (Min Qty, Max Qty)	1.51E+04			1.00E+04			1.75E+04			1.16E+04			2.11E+04			1.41E+04			1.75E+04			1.16E+04								
CV or beta (Min Qty, Max Qty)	0.36			0.36			0.36			0.36			0.37			0.37			0.37			0.37			0.34			0.34		
Quantity Unit:	Each			Each			Each			Each			Each			Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀															
Repair Time by Damage State:	3.85E+00	7.39E+00	1.05E+01	4.44E+00	8.56E+00	1.23E+01	5.61E+00	1.00E+01	1.55E+01	6.52E+00	1.04E+01	1.67E+01	5.32E+00	8.56E+00	1.28E+01															
Best fit mean:	7.39E+00 Normal			8.56E+00 Normal			1.00E+01 Normal			1.04E+01 LogNormal			8.56E+00 LogNormal																	
Best Fit Distribution:																														
Quantity Plateau (Min Qty, Max Qty)	5.00 30.00			5.00 30.00			5.00 30.00			5.00 30.00			5.00 30.00																	
Average Repair Time (Min Qty, Max Qty)	8.87E+00			5.91E+00			1.03E+01			6.85E+00			1.17E+01			8.32E+00			1.24E+01			8.28E+00			1.03E+01			6.85E+00		
CV or beta (Min Qty, Max Qty)	0.44			0.44			0.44			0.44			0.45			0.45			0.45			0.45			0.42			0.42		
Quantity Unit:	Each			Each			Each			Each			Each			Each														
LifeSafety Hazard:	NO			NO			NO			NO			NO			NO														
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO			NO			NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable			Not Applicable			Not Applicable														
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00			0% 0.00			0% 0.00														
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00			0% 0.00			0% 0.00														
Post-event Tagging Flag:	YES			YES			YES			YES			YES			YES														
Unsafe Placard Trigger (Median, Dispersion)	50% 0.50			50% 0.50			50% 0.50			50% 0.50			50% 0.50			50% 0.50														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1035.051

Pre-Northridge WUF-B beam-column joint, beam both sides of column, beam depth <= W27
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 96



Construction Quality: Not Specified
Seismic Installation Conditions: Not Specified

Fragility Unit of Measure:	EA 1
Demand Parameter (unit):	Story Drift Ratio Unit less
Number of Damage States:	5

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Damage State:	DS1	DS2	DS3	DS4	DS5
Type of Damage State:	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive	Sequential
DS Hierarchy	Seq(MutEx(DS1,DS2),MutEx(DS3,DS4),DS5)				
Descriptions	Fracture of lower beam flange weld and failure of web bolts (shear tab connection), with fractures confined to the weld region.	Similar to DS1, except that fracture propagates into column flanges.	Fracture of upper beam flange weld, without DS1 type damage. Fracture is confined to beam flange region.	Similar to DS3, except that fracture propagates into column flanges.	Fracture initiating at weld access hole and propagating through beam flange, possibly accompanied by local buckling deformations of web and flange.

Illustrations

				
B1035.041-DS1-1.JPG	B1035.041-DS2-1.JPG	none	none	none
0.75	0.25	0.75	0.25	1.00

Damage State Probability:	0.75	0.25	0.75	0.25	1.00
Fragility Parameters					
Median Demand, θ :	0.017	0.017	0.025	0.025	0.03
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified	Not Specified	Not Specified
Uncertainty, β_u :	0.4	0.4	0.4	0.4	0.4
Total Dispersion, β :	0.4	0.4	0.4	0.4	0.4

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Average
Data Relevance Average
Documentation Quality Superior
Rationality Superior

Consequence Functions
Repair Description

Repair will typically require gouging out and re-welding of the beam flange weld, repair of shear tab, and replacing shear bolts. Repair and replace partitions at connection.

In addition to column measures for DS1, repairs to column will be necessary. Cover plate, patch, or replace damaged column flange at connection.

Repairs will be similar to those required for DS1, except that access to weld will likely require removal and replacement of a portion of the floor slab above the weld.

In addition to column measures for DS3, repairs to column will be necessary that will involve replacing a portion of the column flange.

In addition to that for DS1 except that a portion of the beam web and flange may need to be heat straightened or replaced.

Long Lead Time (Yes / No)

NO NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀			
Repair Cost by Damage State:	8.54E+03	1.76E+04	2.38E+04	9.54E+03	1.91E+04	2.63E+04	1.36E+04	2.46E+04	3.18E+04	1.37E+04	2.41E+04	3.29E+04	1.03E+04	1.89E+04	2.56E+04			
Best fit mean:	1.67E+04			1.83E+04			2.34E+04			2.36E+04			1.83E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 30.00			5.00 30.00			5.00 30.00			5.00 30.00			5.00 30.00					
Average Repair Cost (Min Qty, Max Qty)	2.11E+04			1.41E+04			2.29E+04			1.53E+04			2.27E+04			1.51E+04		
CV or beta (Min Qty, Max Qty)	0.36			0.36			0.36			0.36			0.30			0.30		
Quantity Unit:	Each			Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀			
Repair Time by Damage State:	5.02E+00	1.03E+01	1.40E+01	5.61E+00	1.12E+01	1.55E+01	8.02E+00	1.45E+01	1.87E+01	8.05E+00	1.42E+01	1.93E+01	6.08E+00	1.11E+01	1.51E+01			
Best fit mean:	1.03E+01			1.12E+01			1.45E+01			1.42E+01			1.11E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 30.00			5.00 30.00			5.00 30.00			5.00 30.00			5.00 30.00					
Average Repair Time (Min Qty, Max Qty)	1.24E+01			8.27E+00			1.35E+01			8.98E+00			1.67E+01			1.22E+01		
CV or beta (Min Qty, Max Qty)	0.44			0.44			0.44			0.44			0.39			0.39		
Quantity Unit:	Each			Each			Each			Each			Each					
LifeSafety Hazard:	NO			NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	YES			YES			YES			YES			YES					
Unsafe Placard Trigger (Median, Dispersion)	50% 0.50			50% 0.50			50% 0.50			50% 0.50			50% 0.50					

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1035.052

Pre-Northridge WUF-B beam-column joint, beam both sides of column, beam depth >= W30
Costing is on a per bay basis. Costing does not include fireproofing removal or reapplication cost.

Line 97



Construction Quality: Not Specified
Seismic Installation Conditions: Not Specified

Fragility Unit of Measure:	EA 1
Demand Parameter (unit):	Story Drift Ratio Unit less
Number of Damage States:	5

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Damage State:	DS1	DS2	DS3	DS4	DS5
Type of Damage State:	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive	Sequential
DS Hierarchy	Seq(MutEx(DS1,DS2),MutEx(DS3,DS4),DS5)				
Descriptions	Fracture of lower beam flange weld and failure of web bolts (shear tab connection), with fractures confined to the weld region.	Similar to DS1, except that fracture propagates into column flanges.	Fracture of upper beam flange weld, without DS1 type damage. Fracture is confined to beam flange region.	Similar to DS3, except that fracture propagates into column flanges.	Fracture initiating at weld access hole and propagating through beam flange, possibly accompanied by local buckling deformations of web and flange.

Illustrations

				
B1035.041-DS1-1.JPG	B1035.041-DS2-1.JPG	none	none	none
0.75	0.25	0.75	0.25	1.00

Damage State Probability:	0.75	0.25	0.75	0.25	1.00
Fragility Parameters					
Median Demand, θ :	0.017	0.017	0.025	0.025	0.03
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified	Not Specified	Not Specified
Uncertainty, β_u :	0.4	0.4	0.4	0.4	0.4
Total Dispersion, β :	0.4	0.4	0.4	0.4	0.4

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Average
Data Relevance Average
Documentation Quality Superior
Rationality Superior

Consequence Functions
Repair Description

Repair will typically require gouging out and re-welding of the beam flange weld, repair of shear tab, and replacing shear bolts. Repair and replace partitions at connection.

In addition to column measures for DS1, repairs to column will be necessary. Cover plate, patch, or replace damaged column flange at connection.

Repairs will be similar to those required for DS1, except that access to weld will likely require removal and replacement of a portion of the floor slab above the weld.

In addition to column measures for DS3, repairs to column will be necessary that will involve replacing a portion of the column flange.

Repair is similar to that for DS1 except that a portion of the beam web and flange may need to be heat straightened or replaced.

Long Lead Time (Yes / No)	NO	NO	NO	NO	NO
Repair Costs:	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}
Repair Cost by Damage State:	8.54E+03 1.76E+04 2.38E+04	9.54E+03 1.91E+04 2.63E+04	1.21E+04 2.21E+04 3.18E+04	1.37E+04 2.41E+04 3.49E+04	9.38E+03 2.39E+04 2.62E+04
Best fit mean:	1.67E+04	1.83E+04	2.20E+04	2.42E+04	1.98E+04
Best Fit Distribution:	Normal	Normal	Normal	Normal	Normal
Quantity Plateau (Min Qty, Max Qty)	5.00 30.00	5.00 30.00	5.00 30.00	5.00 30.00	5.00 30.00
Average Repair Cost (Min Qty, Max Qty)	2.11E+04 0.36 1.41E+04 0.36	2.29E+04 0.36 1.53E+04 0.36	2.87E+04 0.35 1.91E+04 0.35	2.89E+04 0.34 1.93E+04 0.34	2.87E+04 0.33 1.91E+04 0.33
CV or beta (Min Qty, Max Qty)	0.36 0.36	0.36 0.36	0.35 0.35	0.34 0.34	0.33 0.33
Quantity Unit:	Each	Each	Each	Each	Each
Repair Time:	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}
Repair Time by Damage State:	5.02E+00 1.03E+01 1.40E+01	5.61E+00 1.12E+01 1.55E+01	7.14E+00 1.30E+01 1.87E+01	8.05E+00 1.42E+01 2.05E+01	5.52E+00 1.41E+01 1.54E+01
Best fit mean:	1.03E+01	1.12E+01	1.30E+01	1.42E+01	1.41E+01
Best Fit Distribution:	Normal	Normal	Normal	Normal	Normal
Quantity Plateau (Min Qty, Max Qty)	5.00 30.00	5.00 30.00	5.00 30.00	5.00 30.00	5.00 30.00
Average Repair Time (Min Qty, Max Qty)	1.24E+01 0.44 8.27E+00 0.44	1.35E+01 0.44 8.98E+00 0.44	1.58E+01 0.43 1.02E+01 0.43	1.70E+01 0.42 1.14E+01 0.42	1.69E+01 0.41 1.13E+01 0.41
CV or beta (Min Qty, Max Qty)	0.44 0.44	0.44 0.44	0.43 0.43	0.42 0.42	0.41 0.41
Quantity Unit:	Each	Each	Each	Each	Each
LifeSafety Hazard:	NO	NO	NO	NO	NO
Potential non-collapse casualties? (Yes / No)	NO	NO	NO	NO	NO
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Serious Injury (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00	0% 0.00	0% 0.00
Loss of Life (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00	0% 0.00	0% 0.00
Post-event Tagging Flag:	YES	YES	YES	YES	YES
Unsafe Placard Trigger (Median, Dispersion)	50% 0.50	50% 0.50	50% 0.50	50% 0.50	50% 0.50
Comments:	None				
Date Created:	Not Given				
Approved (YES / NO)?	By User				
Official (YES / NO) ?	By User				
Author:	Greg Deierlein				
Revisions:	None				

Root Cost Multiplier: 1




FEMA P-58 Fragility Specification

NISTIR Classification B1035.061a
NISTIR Name EBF Shear Link, no floor beams, link w < 100 PLF
Description Costing is on a per connection basis. Costing does not include fireproofing removal or reapplication cost.

Line 98

Construction Quality:	Not Specified			
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Link Rotation Angle Radians			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Damage to concrete slab above the link Web local buckling, flange local buckling. Initiation of fracture in the link beam and link flange.			

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations				
				
	B1035.061-DS1-1.JPG	B1035.061-DS2-1.JPG	B1035.061-DS3-1.JPG	
Damage State Probability:	1.00	1.00	1.00	
Fragility Parameters				
Median Demand, θ :	0.04	0.06	0.08	
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified	
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified	
Total Dispersion, β :	0.3	0.3	0.3	
Correlation (Yes / No)	NO			
Directionality (Yes / No)	YES			
Quality Ratings				
Data Quality	Superior			
Data Relevance	Superior			
Documentation Quality	Superior			
Rationality	Superior			
Consequence Functions				
Repair Description	Replace concrete slab and finishes in 400 SF at EBF link. Heat straightening of buckled elements. Replace EBF link.			

Long Lead Time (Yes / No)				NO			NO			NO								
Repair Costs:				P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:				4.13E+04	8.26E+04	1.00E+05	4.73E+04	8.86E+04	1.05E+05	7.05E+04	1.13E+05	1.29E+05						
Best fit mean:				7.47E+04			8.02E+04			1.04E+05								
Best Fit Distribution:				Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)				2.00		5.00	2.00		5.00	2.00		5.00						
Average Repair Cost (Min Qty, Max Qty)				9.91E+04		6.61E+04	1.06E+05		7.09E+04	1.36E+05		9.06E+04						
CV or beta (Min Qty, Max Qty)				0.31		0.31	0.28		0.28	0.22		0.22						
Quantity Unit:				Each			Each			Each								
Repair Time:				P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:				2.73E+01	5.47E+01	6.64E+01	3.13E+01	5.86E+01	6.94E+01	4.67E+01	7.50E+01	8.50E+01						
Best fit mean:				5.47E+01			5.86E+01			7.50E+01								
Best Fit Distribution:				Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)				2.00		5.00	2.00		5.00	2.00		5.00						
Average Repair Time (Min Qty, Max Qty)				6.56E+01		4.37E+01	7.04E+01		4.69E+01	9.00E+01		6.00E+01						
CV or beta (Min Qty, Max Qty)				0.40		0.40	0.38		0.38	0.33		0.33						
Quantity Unit:				Each			Each			Each								
LifeSafety Hazard:																		
Potential non-collapse casualties? (Yes / No)				NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:				Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)				0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)				0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:				NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)				0%	0.00		50%	0.50		25%	0.50							
Comments:				None														
Date Created:				Not Given														
Approved (YES / NO)?				By User														
Official (YES / NO) ?				By User														
Author:				Not Given														
Revisions:				None														
				Root Cost Multiplier: 1														

Root Cost Multiplier: 1




FEMA P-58 Fragility Specification

NISTIR Classification B1035.061b
NISTIR Name EBF Shear Link, no floor beams, link w < 200 PLF
Description Costing is on a per connection basis. Costing does not include fireproofing removal or reapplication cost.

Line 99

Construction Quality:	Not Specified			
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Link Rotation Angle Radians			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Damage to concrete slab above the link Web local buckling, flange local buckling. Initiation of fracture in the link beam and link flange.			

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations				
				
	B1035.061-DS1-1.JPG	B1035.061-DS2-1.JPG	B1035.061-DS3-1.JPG	
Damage State Probability:	1.00	1.00	1.00	
Fragility Parameters				
Median Demand, θ :	0.04	0.06	0.08	
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified	
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified	
Total Dispersion, β :	0.3	0.3	0.3	
Correlation (Yes / No)	NO			
Directionality (Yes / No)	YES			
Quality Ratings				
Data Quality	Superior			
Data Relevance	Superior			
Documentation Quality	Superior			
Rationality	Superior			
Consequence Functions				
Repair Description	Replace concrete slab and finishes in 400 SF at EBF link. Heat straightening of buckled elements. Replace EBF link.			

Long Lead Time (Yes / No)				NO			NO			NO														
Repair Costs:				P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀						
Repair Cost by Damage State:				4.13E+04	8.26E+04	1.00E+05	5.03E+04	9.16E+04	1.08E+05	8.25E+04	1.25E+05	1.41E+05												
Best fit mean:				7.47E+04			8.32E+04			1.16E+05														
Best Fit Distribution:				Normal			Normal			Normal														
Quantity Plateau (Min Qty, Max Qty)				2.00		5.00	2.00		5.00	2.00		5.00												
Average Repair Cost (Min Qty, Max Qty)				9.91E+04		6.61E+04	1.10E+05		7.33E+04	1.50E+05		1.00E+05												
CV or beta (Min Qty, Max Qty)				0.31		0.31	0.27		0.27	0.19		0.19												
Quantity Unit:				Each			Each			Each														
Repair Time:				P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀						
Repair Time by Damage State:				2.73E+01	5.47E+01	6.64E+01	3.33E+01	6.06E+01	7.13E+01	5.46E+01	8.29E+01	9.30E+01												
Best fit mean:				5.47E+01			6.06E+01			8.29E+01														
Best Fit Distribution:				Normal			Normal			Normal														
Quantity Plateau (Min Qty, Max Qty)				2.00		5.00	2.00		5.00	2.00		5.00												
Average Repair Time (Min Qty, Max Qty)				6.56E+01		4.37E+01	7.27E+01		4.85E+01	9.95E+01		6.63E+01												
CV or beta (Min Qty, Max Qty)				0.40		0.40	0.37		0.37	0.32		0.32												
Quantity Unit:				Each			Each			Each														
LifeSafety Hazard:																								
Potential non-collapse casualties? (Yes / No)				NO			NO			NO														
Casualty-affected Planar Area (sf) per Normative Unit:				Not Applicable			Not Applicable			Not Applicable														
Serious Injury (Median, Dispersion)				0%	0.00		0%	0.00		0%	0.00													
Loss of Life (Median, Dispersion)				0%	0.00		0%	0.00		0%	0.00													
Post-event Tagging Flag:				NO			YES			YES														
Unsafe Placard Trigger (Median, Dispersion)				0%	0.00		50%	0.50		25%	0.50													
Comments:				None																				
Date Created:				Not Given																				
Approved (YES / NO)?				By User																				
Official (YES / NO) ?				By User																				
Author:				Not Given																				
Revisions:				None																				
													Root Cost Multiplier:		1									

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification




NISTIR Classification B1035.062a
NISTIR Name EBF Shear Link, with floor beams, link w < 100 PLF
Description Costing is on a per connection basis. Costing does not include fireproofing removal or reapplication cost.

Line 100

Construction Quality:	Not Specified			
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Link Rotation Angle Radians			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Damage to concrete slab above the link Web local buckling, flange local buckling. Initiation of fracture in the link beam and link flange.			

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
B1035.061-DS1-1.JPG	B1035.061-DS2-1.JPG	B1035.061-DS3-1.JPG		

Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.04	0.06	0.08		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	0.3	0.3	0.3		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Superior				
Data Relevance	Superior				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Replace concrete slab and finishes in 400 SF at EBF link. Heat straightening of buckled elements. Replace EBF link.				

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀			P ₅₀			P ₉₀			P ₁₀			P ₅₀			P ₉₀			P ₁₀			P ₅₀			P ₉₀											
Repair Cost by Damage State:	4.13E+04			8.26E+04			1.00E+05			4.73E+04			8.86E+04			1.05E+05			8.18E+04			1.26E+05			1.44E+05											
Best fit mean:	7.47E+04									8.02E+04									1.17E+05																	
Best Fit Distribution:	Normal									Normal									Normal																	
Quantity Plateau (Min Qty, Max Qty)	2.00			5.00			2.00			5.00			2.00			5.00																				
Average Repair Cost (Min Qty, Max Qty)	9.91E+04			6.61E+04			1.06E+05			7.09E+04			1.51E+05			1.00E+05																				
CV or beta (Min Qty, Max Qty)	0.31			0.31			0.28			0.28			0.21			0.21																				
Quantity Unit:	Each									Each									Each																	
Repair Time:	P ₁₀			P ₅₀			P ₉₀			P ₁₀			P ₅₀			P ₉₀			P ₁₀			P ₅₀			P ₉₀			P ₁₀			P ₅₀			P ₉₀		
Repair Time by Damage State:	2.73E+01			5.47E+01			6.64E+01			3.13E+01			5.86E+01			6.94E+01			5.41E+01			8.31E+01			9.52E+01											
Best fit mean:	5.47E+01									5.86E+01									8.31E+01																	
Best Fit Distribution:	Normal									Normal									Normal																	
Quantity Plateau (Min Qty, Max Qty)	2.00			5.00			2.00			5.00			2.00			5.00																				
Average Repair Time (Min Qty, Max Qty)	6.56E+01			4.37E+01			7.04E+01			4.69E+01			9.97E+01			6.65E+01																				
CV or beta (Min Qty, Max Qty)	0.40			0.40			0.38			0.38			0.32			0.32																				
Quantity Unit:	Each									Each									Each																	
LifeSafety Hazard:																																				
Potential non-collapse casualties? (Yes / No)	NO									NO									NO																	
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable									Not Applicable									Not Applicable																	
Serious Injury (Median, Dispersion)	0%		0.00								0%		0.00								0%		0.00													
Loss of Life (Median, Dispersion)	0%		0.00								0%		0.00								0%		0.00													
Post-event Tagging Flag:	NO									YES									YES																	
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00								50%		0.50								25%		0.50													
Comments:	None																																			
Date Created:	Not Given																																			
Approved (YES / NO)?	By User																																			
Official (YES / NO) ?	By User																																			
Author:	Not Given																																			
Revisions:	None																																			
	Root Cost Multiplier: 1																																			

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification




NISTIR Classification B1035.062b
NISTIR Name EBF Shear Link, with floor beams, link w < 200 PLF
Description Costing is on a per connection basis. Costing does not include fireproofing removal or reapplication cost.

Line 101

Construction Quality:	Not Specified			
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Link Rotation Angle Radians			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Damage to concrete slab above the link Web local buckling, flange local buckling. Initiation of fracture in the link beam and link flange.			

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
B1035.061-DS1-1.JPG	B1035.061-DS2-1.JPG	B1035.061-DS3-1.JPG		

Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.04	0.06	0.08		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	0.3	0.3	0.3		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Superior				
Data Relevance	Superior				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Replace concrete slab and finishes in 400 SF at EBF link. Heat straightening of buckled elements. Replace EBF link.				

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	4.13E+04	8.26E+04	1.00E+05	5.03E+04	9.16E+04	1.08E+05	9.58E+04	1.41E+05	1.62E+05						
Best fit mean:	7.47E+04			8.32E+04			1.33E+05								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	2.00		5.00	2.00		5.00	2.00		5.00						
Average Repair Cost (Min Qty, Max Qty)	9.91E+04		6.61E+04	1.10E+05		7.33E+04	1.69E+05		1.12E+05						
CV or beta (Min Qty, Max Qty)	0.31		0.31	0.27		0.27	0.19		0.19						
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.73E+01	5.47E+01	6.64E+01	3.33E+01	6.06E+01	7.13E+01	6.34E+01	9.30E+01	1.07E+02						
Best fit mean:	5.47E+01			6.06E+01			9.30E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	2.00		5.00	2.00		5.00	2.00		5.00						
Average Repair Time (Min Qty, Max Qty)	6.56E+01		4.37E+01	7.27E+01		4.85E+01	1.12E+02		7.44E+01						
CV or beta (Min Qty, Max Qty)	0.40		0.40	0.37		0.37	0.32		0.32						
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		50%	0.50		25%	0.50							
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														
	Root Cost Multiplier: 1														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

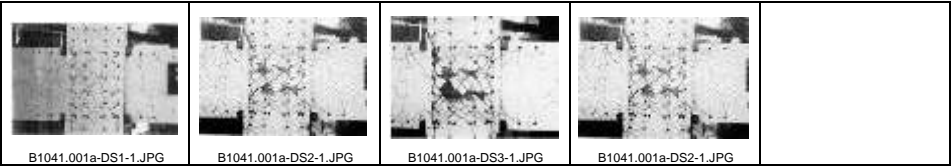
NISTIR Classification B1041.001a
NISTIR Name ACI 318 SMF , Conc Col & Bm = 24" x 24", Beam one side
Description ACI318 Concrete SMF, ductile response. Meets the requirements of ACI318 SMF. Costing is on a per joint basis.

Line 102

Construction Quality:	Not Specified				<div>Quantity Rounding</div> <div>Round Qty?</div> YES
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential		Mutually Exclusive		Mutually Exclusive
DS Hierarchy	Seq(DS1,DS2,MutEx(DS3,DS4))				
Descriptions	Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00	0.80	0.20
Fragility Parameters				
Median Demand, θ :	0.02	0.0275	0.05	0.05
Data dispersion, β_d :	Not Specified	0.28	0.15	0.28
Uncertainty, β_u :	0.4	0.1	0.25	0.1
Total Dispersion, β :	0.4	0.3	0.3	0.3
Correlation (Yes / No)	NO			
Directionality (Yes / No)	YES			
Quality Ratings	Average			
Data Quality	Average			
Data Relevance	Superior			
Documentation Quality	Superior			
Rationality				
Consequence Functions				
Repair Description	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.	Remove furnishings, ceilings and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.85E+04	3.25E+04	4.44E+04	2.30E+04	4.00E+04	5.29E+04	1.85E+04	3.25E+04	4.44E+04			
Best fit mean:	2.09E+04			3.18E+04			3.86E+04			3.18E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 0.39			3.90E+04 0.32			4.80E+04 0.30			3.90E+04 0.32					
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.63E+01	2.87E+01	3.92E+01	2.03E+01	3.53E+01	4.67E+01	1.63E+01	2.87E+01	3.92E+01			
Best fit mean:	1.89E+01			2.87E+01			3.53E+01			2.87E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.27E+01 0.46			3.44E+01 0.40			4.23E+01 0.39			3.44E+01 0.40					
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			NO			YES			NO					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50			0% 0.00					

Comments: Note: DS4 is a copy of DS2 to create a mutually exclusive compliment to DS3.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: None

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

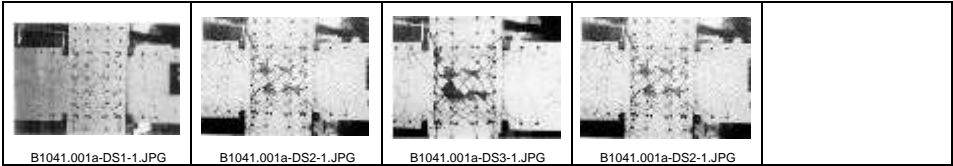
NISTIR Classification B1041.001b
NISTIR Name ACI 318 SMF , Conc Col & Bm = 24" x 24", Beam both sides
Description ACI318 Concrete SMF, ductile response. Meets the requirements of ACI318 SMF. Costing is on a per joint basis.

Line 103

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Mutually Exclusive	Mutually Exclusive	
DS Hierarchy	Seq(DS1,DS2,MutEx(DS3,DS4))				
Descriptions	Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00	0.80	0.20
Fragility Parameters				
Median Demand, θ:	0.02	0.0275	0.05	0.05
Data dispersion, β_d:	Not Specified	0.28	0.15	0.28
Uncertainty, β_u:	0.4	0.1	0.25	0.1
Total Dispersion, β:	0.4	0.3	0.3	0.3
Correlation (Yes / No)	NO			
Directionality (Yes / No)	YES			
Quality Ratings	Average			
Data Quality	Average			
Data Relevance	Average			
Documentation Quality	Superior			
Rationality	Superior			
Consequence Functions				
Repair Description	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.	Remove furnishings, ceilings and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.85E+04	3.25E+04	4.44E+04	2.30E+04	4.00E+04	5.29E+04	1.85E+04	3.25E+04	4.44E+04			
Best fit mean:	2.09E+04			3.18E+04			3.86E+04			3.18E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 0.39			3.90E+04 0.32			4.80E+04 0.30			3.90E+04 0.32					
CV or beta (Min Qty, Max Qty)	0.39			0.32			0.30			0.32					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.63E+01	2.87E+01	3.92E+01	2.03E+01	3.53E+01	4.67E+01	1.63E+01	2.87E+01	3.92E+01			
Best fit mean:	1.89E+01			2.87E+01			3.53E+01			2.87E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.27E+01 0.46			3.44E+01 0.40			4.23E+01 0.39			3.44E+01 0.40					
CV or beta (Min Qty, Max Qty)	0.46			0.40			0.39			0.40					
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			NO			YES			NO					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50			0% 0.00					

Comments: Note: DS4 is a copy of DS2 to create a mutually exclusive compliment to DS3.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: None

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

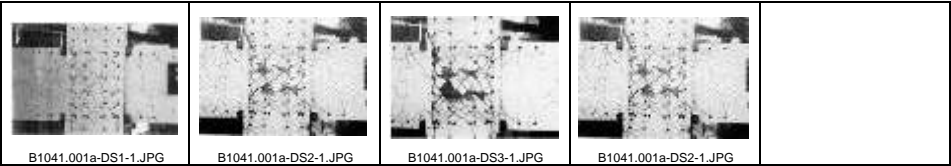
NISTIR Classification B1041.002a
NISTIR Name ACI 318 SMF , Conc Col & Bm = 24" x 36", Beam one side
Description ACI318 Concrete SMF, ductile response. Meets the requirements of ACI318 SMF. Costing is on a per joint basis.

Line 104

Construction Quality:	Not Specified				<div>Quantity Rounding</div> <div>Round Qty?</div> <div>YES</div> <div>Allow sum by floor or building?</div> <div>NO</div> <div>Demand Location (floor above?)</div> <div>No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Mutually Exclusive	Mutually Exclusive	
DS Hierarchy	Seq(DS1,DS2,MutEx(DS3,DS4))				
Descriptions	Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Illustrations



Damage State Probability:	1.00	1.00	0.80	0.20
Fragility Parameters				
Median Demand, θ:	0.02	0.0275	0.05	0.05
Data dispersion, β_d:	Not Specified	0.28	0.15	0.28
Uncertainty, β_u:	0.4	0.1	0.25	0.1
Total Dispersion, β:	0.4	0.3	0.3	0.3
Correlation (Yes / No)	NO			
Directionality (Yes / No)	YES			
Quality Ratings				
Data Quality	Average			
Data Relevance	Average			
Documentation Quality	Superior			
Rationality	Superior			
Consequence Functions				
Repair Description	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.	Remove furnishings, ceilings and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04	1.95E+04	3.45E+04	4.54E+04			
Best fit mean:	2.09E+04			3.31E+04			3.96E+04			3.31E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 0.39 0.39			4.14E+04 0.31 0.31			4.92E+04 0.29 0.29			4.14E+04 0.31 0.31					
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01	1.72E+01	3.04E+01	4.01E+01			
Best fit mean:	1.89E+01			3.04E+01			3.62E+01			3.04E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.27E+01 0.46 0.46			3.65E+01 0.39 0.39			4.34E+01 0.39 0.39			3.65E+01 0.39 0.39					
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			NO			YES			NO					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50			0% 0.00					

Comments: Note: DS4 is a copy of DS2 to create a mutually exclusive compliment to DS3.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: None

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

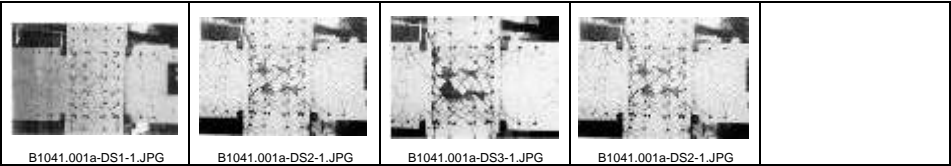
NISTIR Classification B1041.002b
NISTIR Name ACI 318 SMF , Conc Col & Bm = 24" x 36", Beam both sides
Description ACI318 Concrete SMF, ductile response. Meets the requirements of ACI318 SMF. Costing is on a per joint basis.

Line 105

Construction Quality:	Not Specified				<div>Quantity Rounding</div> <div>Round Qty?</div> YES
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Mutually Exclusive	Mutually Exclusive	
DS Hierarchy	Seq(DS1,DS2,MutEx(DS3,DS4))				
Descriptions	Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Illustrations



Damage State Probability:	1.00	1.00	0.80	0.20
Fragility Parameters				
Median Demand, θ :	0.02	0.0275	0.05	0.05
Data dispersion, β_d :	Not Specified	0.28	0.15	0.28
Uncertainty, β_u :	0.4	0.1	0.25	0.1
Total Dispersion, β :	0.4	0.3	0.3	0.3
Correlation (Yes / No)	NO			
Directionality (Yes / No)	YES			
Quality Ratings	Average			
Data Quality	Average			
Data Relevance	Average			
Documentation Quality	Superior			
Rationality	Superior			
Consequence Functions				
Repair Description	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.	Remove furnishings, ceilings and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04	1.95E+04	3.45E+04	4.54E+04			
Best fit mean:	2.09E+04			3.31E+04			3.96E+04			3.31E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 0.39 0.39			4.14E+04 0.31 0.31			4.92E+04 0.29 0.29			4.14E+04 0.31 0.31					
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01	1.72E+01	3.04E+01	4.01E+01			
Best fit mean:	1.89E+01			3.04E+01			3.62E+01			3.04E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.27E+01 0.46 0.46			3.65E+01 0.39 0.39			4.34E+01 0.39 0.39			3.65E+01 0.39 0.39					
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Casualty-affected Planar Area (sf) per Normative Unit:															
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			NO			YES			NO					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50			0% 0.00					

Comments: Note: DS4 is a copy of DS2 to create a mutually exclusive compliment to DS3.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: None

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

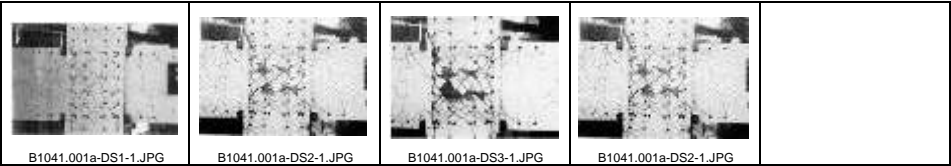
NISTIR Classification B1041.003a
NISTIR Name ACI 318 SMF , Conc Col & Bm = 36" x 36", Beam one side
Description ACI318 Concrete SMF, ductile response. Meets the requirements of ACI318 SMF. Costing is on a per joint basis.

Line 106

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Mutually Exclusive	Mutually Exclusive	
DS Hierarchy	Seq(DS1,DS2,MutEx(DS3,DS4))				
Descriptions	Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00	0.80	0.20
Fragility Parameters				
Median Demand, θ :	0.02	0.0275	0.05	0.05
Data dispersion, β_d :	Not Specified	0.28	0.15	0.28
Uncertainty, β_u :	0.4	0.1	0.25	0.1
Total Dispersion, β :	0.4	0.3	0.3	0.3
Correlation (Yes / No)	NO			
Directionality (Yes / No)	YES			
Quality Ratings	Average			
Data Quality	Average			
Data Relevance	Average			
Documentation Quality	Superior			
Rationality	Superior			
Consequence Functions				
Repair Description	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.	Remove furnishings, ceilings and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04	1.95E+04	3.45E+04	4.54E+04			
Best fit mean:	2.09E+04			3.31E+04			3.96E+04			3.31E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 0.39			4.14E+04 0.31			4.92E+04 0.29			4.14E+04 0.31					
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01	1.72E+01	3.04E+01	4.01E+01			
Best fit mean:	1.89E+01			3.04E+01			3.62E+01			3.04E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.27E+01 0.46			3.65E+01 0.39			4.34E+01 0.39			3.65E+01 0.39					
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Casualty-affected Planar Area (sf) per Normative Unit:															
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			NO			YES			NO					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50			0% 0.00					
Note: DS4 is a copy of DS2 to create a mutually exclusive compliment to DS3.															

Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: None

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

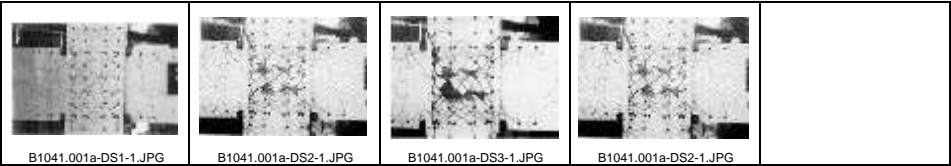
NISTIR Classification B1041.003b
NISTIR Name ACI 318 SMF , Conc Col & Bm = 36" x 36", Beam both sides
Description ACI318 Concrete SMF, ductile response. Meets the requirements of ACI318 SMF. Costing is on a per joint basis.

Line 107

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Mutually Exclusive	Mutually Exclusive	
DS Hierarchy	Seq(DS1,DS2,MutEx(DS3,DS4))				
Descriptions	Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00	0.80	0.20
Fragility Parameters				
Median Demand, θ :	0.02	0.0275	0.05	0.05
Data dispersion, β_d :	Not Specified	0.28	0.15	0.28
Uncertainty, β_u :	0.4	0.1	0.25	0.1
Total Dispersion, β :	0.4	0.3	0.3	0.3
Correlation (Yes / No)	NO			
Directionality (Yes / No)	YES			
Quality Ratings				
Data Quality	Average			
Data Relevance	Average			
Documentation Quality	Superior			
Rationality	Superior			
Consequence Functions				
Repair Description	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.	Remove furnishings, ceilings and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04	1.95E+04	3.45E+04	4.54E+04			
Best fit mean:	2.09E+04			3.31E+04			3.96E+04			3.31E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 0.39 0.39			4.14E+04 0.31 0.31			4.92E+04 0.29 0.29			4.14E+04 0.31 0.31					
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01	1.72E+01	3.04E+01	4.01E+01			
Best fit mean:	1.89E+01			3.04E+01			3.62E+01			3.04E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.27E+01 0.46 0.46			3.65E+01 0.39 0.39			4.34E+01 0.39 0.39			3.65E+01 0.39 0.39					
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			NO			YES			NO					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50			0% 0.00					

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1041.011a

MF with SMF-conforming beam and column flexural and confinement reinforcement but weak joints , Conc Col & Bm = 24" x 24", Beam one side
Non-conforming SMF, joint shear damage, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) Column Pu < 0.6f'cAg, (3) Column flexural response with HIGH ductility, (4) Beam compliant transverse reinforcing with low beam V/bwd(f'c)*0.5, (5) Joints with compliant transverse reinforcing details with spacing < d(column)/2 and Joint V/Vn < 1.2. Costing is on a per joint basis.

Construction Quality:
Seismic Installation Conditions:

Not Specified
Not Specified

Fragility Unit of Measure:
Demand Parameter (unit):

EA 1
Story Drift Ratio Unit less

Quantity Rounding Round Qty? YES
Allow sum by floor or building? NO
Demand Location (floor above?) No

Number of Damage States:
Damage State:

4
DS1 DS2 DS3 DS4

Type of Damage State:
DS Hierarchy

Sequential Sequential Mutually Exclusive Mutually Exclusive

Descriptions

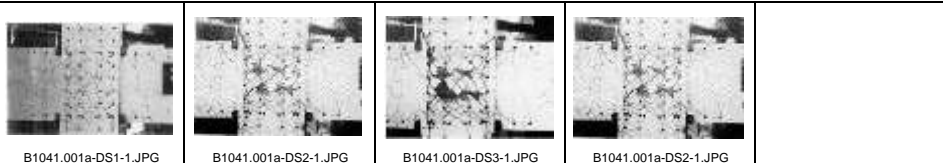
Seq(DS1,DS2,MutEx(DS3,DS4))
Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Illustrations



Damage State Probability:
Fragility Parameters

1.00 1.00 0.50 0.50

Median Demand, θ :
Data dispersion, β_d :
Uncertainty, β_u :
Total Dispersion, β :

0.02 0.025 0.04 0.04
0.07 0.30 0.2 0.3
0.4 0.1 0.25 0.1
0.4 0.3 0.3 0.3

Correlation (Yes / No)
Directionality (Yes / No)

NO
YES

Quality Ratings
Data Quality
Data Relevance
Documentation Quality
Rationality
Consequence Functions

Average
Average
Superior
Superior

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:

Repair Cost by Damage State:
Best fit mean:
Best Fit Distribution:
Quantity Plateau (Min Qty, Max Qty)
Average Repair Cost (Min Qty, Max Qty)
CV or beta (Min Qty, Max Qty)

1.02E+04 2.14E+04 3.11E+04 1.85E+04 3.25E+04 4.44E+04 2.30E+04 4.00E+04 5.29E+04 1.85E+04 3.25E+04 4.44E+04
2.09E+04 Normal 3.18E+04 Normal 3.86E+04 Normal 3.18E+04 Normal
5.00 20.00 5.00 20.00 5.00 20.00 5.00 20.00
2.57E+04 1.71E+04 3.90E+04 2.60E+04 4.80E+04 3.20E+04 3.90E+04 2.60E+04
0.39 0.39 0.32 0.32 0.30 0.30 0.32 0.32

Quantity Unit:

Each Each Each Each

Repair Time:

Repair Time by Damage State:
Best fit mean:
Best Fit Distribution:
Quantity Plateau (Min Qty, Max Qty)
Average Repair Time (Min Qty, Max Qty)
CV or beta (Min Qty, Max Qty)

8.98E+00 1.89E+01 2.75E+01 1.63E+01 2.87E+01 3.92E+01 2.03E+01 3.53E+01 4.67E+01 1.63E+01 2.87E+01 3.92E+01
1.89E+01 Normal 2.87E+01 Normal 3.53E+01 Normal 2.87E+01 Normal
5.00 20.00 5.00 20.00 5.00 20.00 5.00 20.00
2.27E+01 1.51E+01 3.44E+01 2.29E+01 4.23E+01 2.82E+01 3.44E+01 2.29E+01
0.46 0.46 0.40 0.40 0.39 0.39 0.40 0.40

Quantity Unit:

Each Each Each Each

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

NO NO NO NO

Casualty-affected Planar Area (sf) per Normative Unit:

Not Applicable Not Applicable Not Applicable Not Applicable

Serious Injury (Median, Dispersion)

0% 0.00 0% 0.00 0% 0.00 0% 0.00

Loss of Life (Median, Dispersion)

0% 0.00 0% 0.00 0% 0.00 0% 0.00

Post-event Tagging Flag:
Unsafe Placard Trigger (Median, Dispersion)

NO YES NO NO
0% 0.00 0% 0.00 20% 0.50 0% 0.00

Comments:

Note: DS4 is a copy of DS2 to create a mutually exclusive compliment to DS3.

Date Created:
Approved (YES / NO)?
Official (YES / NO) ?


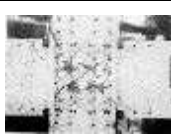
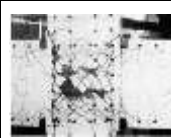

Not Given
By User
By User

Author:
Revisions:

Laura Lowes
None

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification		B1041.011b				Line 109
NISTIR Name		MF with SMF-conforming beam and column flexural and confinement reinforcement but weak joints , Conc Col & Bm = 24" x 24", Beam both sides				
Description		Non-conforming SMF, joint shear damage, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) Column Pu < 0.6f'cAg, (3) Column flexural response with HIGH ductility, (4) Beam compliant transverse reinforcing with low beam V/bwd(f'c)^0.5, (5) Joints with compliant transverse reinforcing details with spacing < d(column)/2 and Joint V/Vn < 1.2. Costing is on a per joint basis.				
Construction Quality:		Not Specified				
Seismic Installation Conditions:		Not Specified				
Fragility Unit of Measure:		EA 1				Quantity Rounding Round Qty? YES
Demand Parameter (unit):		Story Drift Ratio Unit less				Allow sum by floor or building? NO
Number of Damage States:		4				Demand Location (floor above?) No
Damage State:		DS1	DS2	DS3	DS4	
Type of Damage State:		Sequential	Sequential	Mutually Exclusive	Mutually Exclusive	
DS Hierarchy		Seq(DS1,DS2,MutEx(DS3,DS4))				
Descriptions		Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	
Illustrations						
Damage State Probability:		1.00	1.00	0.50	0.50	
Fragility Parameters						
Median Demand, θ:		0.02	0.025	0.04	0.04	
Data dispersion, β_d:		0.07	0.30	0.2	0.3	
Uncertainty, β_u:		0.4	0.1	0.25	0.1	
Total Dispersion, β:		0.4	0.3	0.3	0.3	
Correlation (Yes / No)		NO				
Directionality (Yes / No)		YES				
Quality Ratings						
Data Quality		Average				
Data Relevance		Average				
Documentation Quality		Superior				
Rationality		Superior				
Consequence Functions						
Repair Description		Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.	Remove furnishings, ceilings and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	
Long Lead Time (Yes / No)		NO	NO	NO	NO	
Repair Costs:		P₁₀ P₅₀ P₉₀	P₁₀ P₅₀ P₉₀	P₁₀ P₅₀ P₉₀	P₁₀ P₅₀ P₉₀	P₁₀ P₅₀ P₉₀
Repair Cost by Damage State:		1.02E+04 2.14E+04 3.11E+04	1.85E+04 3.25E+04 4.44E+04	2.30E+04 4.00E+04 5.29E+04	1.85E+04 3.25E+04 4.44E+04	
Best fit mean:		2.09E+04	3.18E+04	3.86E+04	3.18E+04	
Best Fit Distribution:		Normal	Normal	Normal	Normal	
Quantity Plateau (Min Qty, Max Qty)		5.00 20.00	5.00 20.00	5.00 20.00	5.00 20.00	
Average Repair Cost (Min Qty, Max Qty)		2.57E+04 0.39 1.71E+04 0.39	3.90E+04 0.32 2.60E+04 0.32	4.80E+04 0.30 3.20E+04 0.30	3.90E+04 0.32 2.60E+04 0.32	
CV or beta (Min Qty, Max Qty)						
Quantity Unit:		Each	Each	Each	Each	
Repair Time:		P₁₀ P₅₀ P₉₀	P₁₀ P₅₀ P₉₀	P₁₀ P₅₀ P₉₀	P₁₀ P₅₀ P₉₀	P₁₀ P₅₀ P₉₀
Repair Time by Damage State:		8.98E+00 1.89E+01 2.75E+01	1.63E+01 2.87E+01 3.92E+01	2.03E+01 3.53E+01 4.67E+01	1.63E+01 2.87E+01 3.92E+01	
Best fit mean:		1.89E+01	2.87E+01	3.53E+01	2.87E+01	
Best Fit Distribution:		Normal	Normal	Normal	Normal	
Quantity Plateau (Min Qty, Max Qty)		5.00 20.00	5.00 20.00	5.00 20.00	5.00 20.00	
Average Repair Time (Min Qty, Max Qty)		2.27E+01 0.46 1.51E+01 0.46	3.44E+01 0.40 2.29E+01 0.40	4.23E+01 0.39 2.82E+01 0.39	3.44E+01 0.40 2.29E+01 0.40	
CV or beta (Min Qty, Max Qty)						
Quantity Unit:		Each	Each	Each	Each	
LifeSafety Hazard:						
Potential non-collapse casualties? (Yes / No)		NO	NO	NO	NO	
Casualty-affected Planar Area (sf) per Normative Unit:		Not Applicable	Not Applicable	Not Applicable	Not Applicable	
Serious Injury (Median, Dispersion)		0% 0.00	0% 0.00	0% 0.00	0% 0.00	
Loss of Life (Median, Dispersion)		0% 0.00	0% 0.00	0% 0.00	0% 0.00	
Post-event Tagging Flag:		NO	NO	YES	NO	
Unsafe Placard Trigger (Median, Dispersion)		0% 0.00	0% 0.00	20% 0.50	0% 0.00	
Comments:		Note: DS4 is a copy of DS2 to create a mutually exclusive compliment to DS3.				
Date Created:		Not Given				Root Cost Multiplier: 1
Approved (YES / NO)?		By User				
Official (YES / NO) ?		By User				
Author:		Laura Lowes				
Revisions:		None				

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1041.012a

MF with SMF-conforming beam and column flexural and confinement reinforcement but weak joints , Conc Col & Bm = 24" x 36", Beam one side
Non-conforming SMF, joint shear damage, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) Column Pu < 0.6f'cAg, (3) Column flexural response with HIGH ductility, (4) Beam compliant transverse reinforcing with low beam V/bwd(f'c)*0.5, (5) Joints with compliant transverse reinforcing details with spacing < d(column)/2 and Joint V/Vn < 1.2. Costing is on a per joint basis.

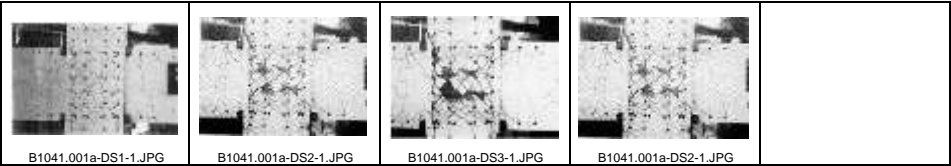
Construction Quality: Not Specified
Seismic Installation Conditions: Not Specified

Fragility Unit of Measure: EA 1
Demand Parameter (unit): Story Drift Ratio Unit less

Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Mutually Exclusive	Mutually Exclusive	
DS Hierarchy	Seq(DS1,DS2,MutEx(DS3,DS4))				
Descriptions	Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00	0.50	0.50	
Fragility Parameters					
Median Demand, θ :	0.02	0.025	0.04	0.04	
Data dispersion, β_d :	0.07	0.30	0.2	0.3	
Uncertainty, β_u :	0.4	0.1	0.25	0.1	
Total Dispersion, β :	0.4	0.3	0.3	0.3	

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Average
Data Relevance Average
Documentation Quality Superior
Rationality Superior
Consequence Functions

Repair Description	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.	Remove furnishings, ceilings and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	
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Long Lead Time (Yes / No) NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04	1.95E+04	3.45E+04	4.54E+04			
Best fit mean:	2.09E+04			3.31E+04			3.96E+04			3.31E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 0.39 0.39			4.14E+04 0.31 0.31			4.92E+04 0.29 0.29			4.14E+04 0.31 0.31					
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01	1.72E+01	3.04E+01	4.01E+01			
Best fit mean:	1.89E+01			3.04E+01			3.62E+01			3.04E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.27E+01 0.46 0.46			3.65E+01 0.39 0.39			4.34E+01 0.39 0.39			3.65E+01 0.39 0.39					
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			NO			YES			NO					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50			0% 0.00					


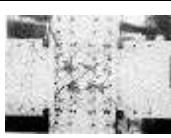
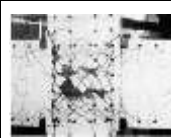

Comments: Note: DS4 is a copy of DS2 to create a mutually exclusive compliment to DS3.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: None

Root Cost Multiplier: 1

Line 111

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification		B1041.013a				Line 112
NISTIR Name		MF with SMF-conforming beam and column flexural and confinement reinforcement but weak joints , Conc Col & Bm = 36" x 36", Beam one side				
Description		Non-conforming SMF, joint shear damage, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) Column Pu < 0.6f'cAg, (3) Column flexural response with HIGH ductility, (4) Beam compliant transverse reinforcing with low beam V/bwd(f'c)^0.5, (5) Joints with compliant transverse reinforcing details with spacing < d(column)/2 and Joint V/Vn < 1.2. Costing is on a per joint basis.				
Construction Quality:		Not Specified				
Seismic Installation Conditions:		Not Specified				
Fragility Unit of Measure:		EA 1				
Demand Parameter (unit):		Story Drift Ratio Unit less				
Number of Damage States:		4				
Damage State:		DS1	DS2	DS3	DS4	
Type of Damage State:		Sequential	Sequential	Mutually Exclusive	Mutually Exclusive	
DS Hierarchy		Seq(DS1,DS2,MutEx(DS3,DS4))				
Descriptions		Seq(DS1,DS2,MutEx(DS3,DS4)) Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	
Illustrations						
Damage State Probability:		1.00	1.00	0.50	0.50	
Fragility Parameters						
Median Demand, θ :		0.02	0.025	0.04	0.04	
Data dispersion, β_d :		0.07	0.30	0.2	0.3	
Uncertainty, β_u :		0.4	0.1	0.25	0.1	
Total Dispersion, β :		0.4	0.3	0.3	0.3	
Correlation (Yes / No)		NO				
Directionality (Yes / No)		YES				
Quality Ratings		Average				
Data Quality		Average				
Data Relevance		Average				
Documentation Quality		Superior				
Rationality		Superior				
Consequence Functions						
Repair Description		Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.	Remove furnishings, ceilings and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	
Long Lead Time (Yes / No)		NO	NO	NO	NO	
Repair Costs:		P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}
Repair Cost by Damage State:		1.02E+04 2.14E+04 3.11E+04	1.95E+04 3.45E+04 4.54E+04	2.40E+04 4.10E+04 5.39E+04	1.95E+04 3.45E+04 4.54E+04	
Best fit mean:		2.09E+04	3.31E+04	3.96E+04	3.31E+04	
Best Fit Distribution:		Normal	Normal	Normal	Normal	
Quantity Plateau (Min Qty, Max Qty)		5.00 20.00	5.00 20.00	5.00 20.00	5.00 20.00	
Average Repair Cost (Min Qty, Max Qty)		2.57E+04 0.39 1.71E+04 0.39	4.14E+04 0.31 2.76E+04 0.31	4.92E+04 0.29 3.28E+04 0.29	4.14E+04 0.31 2.76E+04 0.31	
CV or beta (Min Qty, Max Qty)						
Quantity Unit:		Each	Each	Each	Each	
Repair Time:		P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}
Repair Time by Damage State:		8.98E+00 1.89E+01 2.75E+01	1.72E+01 3.04E+01 4.01E+01	2.12E+01 3.62E+01 4.76E+01	1.72E+01 3.04E+01 4.01E+01	
Best fit mean:		1.89E+01	3.04E+01	3.62E+01	3.04E+01	
Best Fit Distribution:		Normal	Normal	Normal	Normal	
Quantity Plateau (Min Qty, Max Qty)		5.00 20.00	5.00 20.00	5.00 20.00	5.00 20.00	
Average Repair Time (Min Qty, Max Qty)		2.27E+01 0.46 1.51E+01 0.46	3.65E+01 0.39 2.43E+01 0.39	4.34E+01 0.39 2.89E+01 0.39	3.65E+01 0.39 2.43E+01 0.39	
CV or beta (Min Qty, Max Qty)						
Quantity Unit:		Each	Each	Each	Each	
LifeSafety Hazard:						
Potential non-collapse casualties? (Yes / No)		NO	NO	NO	NO	
Casualty-affected Planar Area (sf) per Normative Unit:		Not Applicable	Not Applicable	Not Applicable	Not Applicable	
Serious Injury (Median, Dispersion)		0% 0.00	0% 0.00	0% 0.00	0% 0.00	
Loss of Life (Median, Dispersion)		0% 0.00	0% 0.00	0% 0.00	0% 0.00	
Post-event Tagging Flag:		NO	NO	YES	NO	
Unsafe Placard Trigger (Median, Dispersion)		0% 0.00	0% 0.00	20% 0.50	0% 0.00	
Comments:		Note: DS4 is a copy of DS2 to create a mutually exclusive compliment to DS3.				
Date Created:		Not Given				
Approved (YES / NO)?		By User				
Official (YES / NO) ?		By User				
Author:		Laura Lowes				
Revisions:		None				
Root Cost Multiplier:		1				

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1041.013b

MF with SMF-conforming beam and column flexural and confinement reinforcement but weak joints , Conc Col & Bm = 36" x 36", Beam both sides
Non-conforming SMF, joint shear damage, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) Column Pu < 0.6f'cAg, (3) Column flexural response with HIGH ductility, (4) Beam compliant transverse reinforcing with low beam V/bwd(f'c)*0.5, (5) Joints with compliant transverse reinforcing details with spacing < d(column)/2 and Joint V/Vn < 1.2. Costing is on a per joint basis.

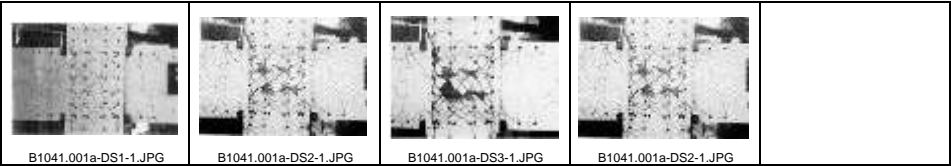
Construction Quality: Not Specified
Seismic Installation Conditions: Not Specified

Fragility Unit of Measure: EA 1
Demand Parameter (unit): Story Drift Ratio Unit less

Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Mutually Exclusive	Mutually Exclusive	
DS Hierarchy	Seq(DS1,DS2,MutEx(DS3,DS4))				
Descriptions	Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00	0.50	0.50	
Fragility Parameters					
Median Demand, θ :	0.02	0.025	0.04	0.04	
Data dispersion, β_d :	0.07	0.30	0.2	0.3	
Uncertainty, β_u :	0.4	0.1	0.25	0.1	
Total Dispersion, β :	0.4	0.3	0.3	0.3	

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Average
Data Relevance Average
Documentation Quality Superior
Rationality Superior
Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No) NO NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04	1.95E+04	3.45E+04	4.54E+04			
Best fit mean:	2.09E+04			3.31E+04			3.96E+04			3.31E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	2.57E+04			4.14E+04			4.92E+04			4.14E+04			2.76E+04		
CV or beta (Min Qty, Max Qty)	0.39 0.39			0.31 0.31			0.29 0.29			0.31 0.31					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01	1.72E+01	3.04E+01	4.01E+01			
Best fit mean:	1.89E+01			3.04E+01			3.62E+01			3.04E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.27E+01			3.65E+01			4.34E+01			3.65E+01			2.43E+01		
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.39 0.39			0.39 0.39			0.39 0.39					
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			NO			YES			NO					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50			0% 0.00					

Comments: Note: DS4 is a copy of DS2 to create a mutually exclusive compliment to DS3.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: None

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1041.021a

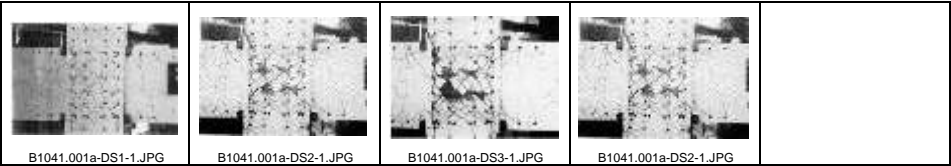
ACI 318 IMF, Conc Col & Bm = 24" x 24", Beam one side
ACI318 IMF, joint shear damage or failure, beam or column flexure-shear response. Meets the following requirements: (1) Column Pu < 0.3Agfc. Costing is on a per joint basis.

Line 114

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Mutually Exclusive	Mutually Exclusive	
DS Hierarchy	Seq(DS1,DS2,MutEx(DS3,DS4))				
Descriptions	Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Illustrations



Damage State Probability:	1.00	1.00	0.40	0.60
Fragility Parameters				
Median Demand, θ :	0.02	0.025	0.035	0.035
Data dispersion, β_d :	0.06	0.30	0.2	0.3
Uncertainty, β_u :	0.4	0.1	0.1	0.1
Total Dispersion, β :	0.4	0.3	0.3	0.3
Correlation (Yes / No)	NO			
Directionality (Yes / No)	YES			
Quality Ratings				
Data Quality	Average			
Data Relevance	Average			
Documentation Quality	Superior			
Rationality	Superior			
Consequence Functions				
Repair Description	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.	Remove furnishings, ceilings and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.85E+04	3.25E+04	4.44E+04	2.30E+04	4.00E+04	5.29E+04	1.85E+04	3.25E+04	4.44E+04			
Best fit mean:	2.09E+04			3.18E+04			3.86E+04			3.18E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 0.39			3.90E+04 0.32			4.80E+04 0.30			3.90E+04 0.32					
CV or beta (Min Qty, Max Qty)	0.39			0.32			0.30			0.32					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.63E+01	2.87E+01	3.92E+01	2.03E+01	3.53E+01	4.67E+01	1.63E+01	2.87E+01	3.92E+01			
Best fit mean:	1.89E+01			2.87E+01			3.53E+01			2.87E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.27E+01 0.46			3.44E+01 0.40			4.23E+01 0.39			3.44E+01 0.40					
CV or beta (Min Qty, Max Qty)	0.46			0.40			0.39			0.40					
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			NO			YES			NO					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50			0% 0.00					

Comments: Note: DS4 is a copy of DS2 to create a mutually exclusive compliment to DS3.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: 2011-08-24 Changed DS4 beta from 0.4 to 0.3 to avoid negative probability.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1041.021b

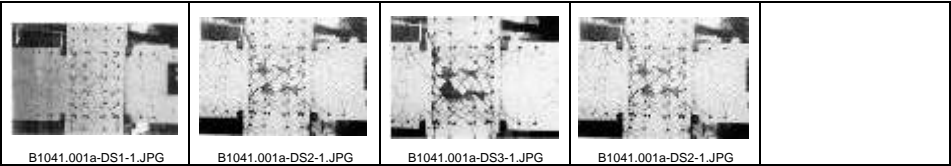
ACI 318 IMF, Conc Col & Bm = 24" x 24", Beam both sides
ACI318 IMF, joint shear damage or failure, beam or column flexure-shear response. Meets the following requirements: (1) Column Pu < 0.3Agfc. Costing is on a per joint basis.

Line 115

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Mutually Exclusive	Mutually Exclusive	
DS Hierarchy	Seq(DS1,DS2,MutEx(DS3,DS4))				
Descriptions	Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00	0.40	0.60
Fragility Parameters				
Median Demand, θ :	0.02	0.025	0.035	0.035
Data dispersion, β_d :	0.06	0.30	0.2	0.3
Uncertainty, β_u :	0.4	0.1	0.1	0.1
Total Dispersion, β :	0.4	0.3	0.3	0.3
Correlation (Yes / No)	NO			
Directionality (Yes / No)	YES			
Quality Ratings				
Data Quality	Average			
Data Relevance	Average			
Documentation Quality	Superior			
Rationality	Superior			
Consequence Functions				
Repair Description	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.	Remove furnishings, ceilings and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.85E+04	3.25E+04	4.44E+04	2.30E+04	4.00E+04	5.29E+04	1.85E+04	3.25E+04	4.44E+04			
Best fit mean:	2.09E+04			3.18E+04			3.86E+04			3.18E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 0.39			3.90E+04 0.32			4.80E+04 0.30			3.90E+04 0.32					
CV or beta (Min Qty, Max Qty)	0.39			0.32			0.30			0.32					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.63E+01	2.87E+01	3.92E+01	2.03E+01	3.53E+01	4.67E+01	1.63E+01	2.87E+01	3.92E+01			
Best fit mean:	1.89E+01			2.87E+01			3.53E+01			2.87E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.27E+01 0.46			3.44E+01 0.40			4.23E+01 0.39			3.44E+01 0.40					
CV or beta (Min Qty, Max Qty)	0.46			0.40			0.39			0.40					
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			NO			YES			NO					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50			0% 0.00					

Comments: Note: DS4 is a copy of DS2 to create a mutually exclusive compliment to DS3.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: 2011-08-24 Changed DS4 beta from 0.4 to 0.3 to avoid negative probability.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1041.022a

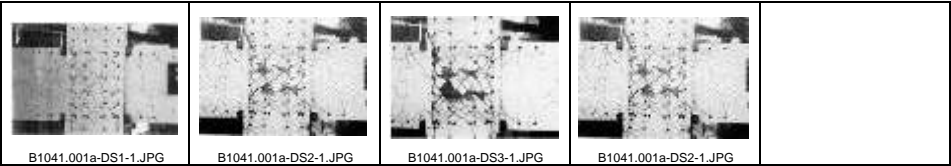
ACI 318 IMF, Conc Col & Bm = 24" x 36", Beam one side
ACI318 IMF, joint shear damage or failure, beam or column flexure-shear response. Meets the following requirements: (1) Column Pu < 0.3Agfc. Costing is on a per joint basis.

Line 116

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Mutually Exclusive	Mutually Exclusive	
DS Hierarchy	Seq(DS1,DS2,MutEx(DS3,DS4))				
Descriptions	Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00	0.40	0.60
Fragility Parameters				
Median Demand, θ :	0.02	0.025	0.035	0.035
Data dispersion, β_d :	0.06	0.30	0.2	0.3
Uncertainty, β_u :	0.4	0.1	0.1	0.1
Total Dispersion, β :	0.4	0.3	0.3	0.3
Correlation (Yes / No)	NO			
Directionality (Yes / No)	YES			
Quality Ratings				
Data Quality	Average			
Data Relevance	Average			
Documentation Quality	Superior			
Rationality	Superior			
Consequence Functions				
Repair Description	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.	Remove furnishings, ceilings and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)





NO NO NO NO

Repair Costs:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04	1.95E+04	3.45E+04	4.54E+04			
Best fit mean:	2.09E+04			3.31E+04			3.96E+04			3.31E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 0.39			4.14E+04 0.31			4.92E+04 0.29			4.14E+04 0.31					
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01	1.72E+01	3.04E+01	4.01E+01			
Best fit mean:	1.89E+01			3.04E+01			3.62E+01			3.04E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.27E+01 0.46			3.65E+01 0.39			4.34E+01 0.39			3.65E+01 0.39					
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			NO			YES			NO					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50			0% 0.00					

Comments: Note: DS4 is a copy of DS2 to create a mutually exclusive compliment to DS3.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: 2011-08-24 Changed DS4 beta from 0.4 to 0.3 to avoid negative probability.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification		B1041.022b				Line 117
NISTIR Name		ACI 318 IMF, Conc Col & Bm = 24" x 36", Beam both sides				
Description		ACI318 IMF, joint shear damage or failure, beam or column flexure-shear response. Meets the following requirements: (1) Column Pu < 0.3Agf'c. Costing is on a per joint basis.				
Construction Quality:		Not Specified				
Seismic Installation Conditions:		Not Specified				
Fragility Unit of Measure:		EA 1				Quantity Rounding Round Qty? YES
Demand Parameter (unit):		Story Drift Ratio Unit less				Allow sum by floor or building? NO
Number of Damage States:		4				Demand Location (floor above?) No
Damage State:		DS1	DS2	DS3	DS4	
Type of Damage State:		Sequential	Sequential	Mutually Exclusive	Mutually Exclusive	
DS Hierarchy		Seq(DS1,DS2,MutEx(DS3,DS4))				
Descriptions		Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	
Illustrations						
Damage State Probability:		1.00	1.00	0.40	0.60	
Fragility Parameters						
Median Demand, θ:		0.02	0.025	0.035	0.035	
Data dispersion, β_d:		0.06	0.30	0.2	0.3	
Uncertainty, β_u:		0.4	0.1	0.1	0.1	
Total Dispersion, β:		0.4	0.3	0.3	0.3	
Correlation (Yes / No)		NO				
Directionality (Yes / No)		YES				
Quality Ratings						
Data Quality		Average				
Data Relevance		Average				
Documentation Quality		Superior				
Rationality		Superior				
Consequence Functions						
Repair Description		Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.	Remove furnishings, ceilings and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	
Long Lead Time (Yes / No)		NO	NO	NO	NO	
Repair Costs:		P₁₀ P₅₀ P₉₀	P₁₀ P₅₀ P₉₀	P₁₀ P₅₀ P₉₀	P₁₀ P₅₀ P₉₀	P₁₀ P₅₀ P₉₀
Repair Cost by Damage State:		1.02E+04 2.14E+04 3.11E+04	1.95E+04 3.45E+04 4.54E+04	2.40E+04 4.10E+04 5.39E+04	1.95E+04 3.45E+04 4.54E+04	
Best fit mean:		2.09E+04	3.31E+04	3.96E+04	3.31E+04	
Best Fit Distribution:		Normal	Normal	Normal	Normal	
Quantity Plateau (Min Qty, Max Qty)		5.00 20.00	5.00 20.00	5.00 20.00	5.00 20.00	
Average Repair Cost (Min Qty, Max Qty)		2.57E+04 0.39 1.71E+04 0.39	4.14E+04 0.31 2.76E+04 0.31	4.92E+04 0.29 3.28E+04 0.29	4.14E+04 0.31 2.76E+04 0.31	
CV or beta (Min Qty, Max Qty)						
Quantity Unit:		Each	Each	Each	Each	
Repair Time:		P₁₀ P₅₀ P₉₀	P₁₀ P₅₀ P₉₀	P₁₀ P₅₀ P₉₀	P₁₀ P₅₀ P₉₀	P₁₀ P₅₀ P₉₀
Repair Time by Damage State:		8.98E+00 1.89E+01 2.75E+01	1.72E+01 3.04E+01 4.01E+01	2.12E+01 3.62E+01 4.76E+01	1.72E+01 3.04E+01 4.01E+01	
Best fit mean:		1.89E+01	3.04E+01	3.62E+01	3.04E+01	
Best Fit Distribution:		Normal	Normal	Normal	Normal	
Quantity Plateau (Min Qty, Max Qty)		5.00 20.00	5.00 20.00	5.00 20.00	5.00 20.00	
Average Repair Time (Min Qty, Max Qty)		2.27E+01 0.46 1.51E+01 0.46	3.65E+01 0.39 2.43E+01 0.39	4.34E+01 0.39 2.89E+01 0.39	3.65E+01 0.39 2.43E+01 0.39	
CV or beta (Min Qty, Max Qty)						
Quantity Unit:		Each	Each	Each	Each	
LifeSafety Hazard:						
Potential non-collapse casualties? (Yes / No)		NO	NO	NO	NO	
Casualty-affected Planar Area (sf) per Normative Unit:		Not Applicable	Not Applicable	Not Applicable	Not Applicable	
Serious Injury (Median, Dispersion)		0% 0.00	0% 0.00	0% 0.00	0% 0.00	
Loss of Life (Median, Dispersion)		0% 0.00	0% 0.00	0% 0.00	0% 0.00	
Post-event Tagging Flag:		NO	NO	YES	NO	
Unsafe Placard Trigger (Median, Dispersion)		0% 0.00	0% 0.00	20% 0.50	0% 0.00	
Comments:		Note: DS4 is a copy of DS2 to create a mutually exclusive compliment to DS3.				
Date Created:		Not Given				Root Cost Multiplier: 1
Approved (YES / NO)?		By User				
Official (YES / NO) ?		By User				
Author:		Laura Lowes				
Revisions:		2011-08-24 Changed DS4 beta from 0.4 to 0.3 to avoid negative probability.				

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1041.023a

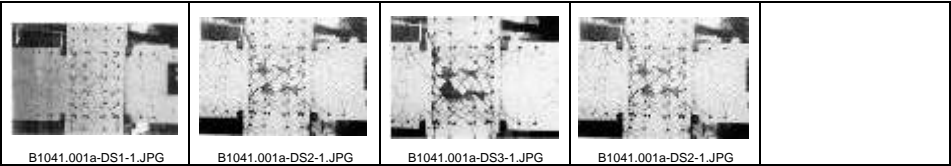
ACI 318 IMF, Conc Col & Bm = 36" x 36", Beam one side
ACI318 IMF, joint shear damage or failure, beam or column flexure-shear response. Meets the following requirements: (1) Column Pu < 0.3Agfc. Costing is on a per joint basis.

Line 118

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Mutually Exclusive	Mutually Exclusive	
DS Hierarchy	Seq(DS1,DS2,MutEx(DS3,DS4))				
Descriptions	Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00	0.40	0.60
Fragility Parameters				
Median Demand, θ :	0.02	0.025	0.035	0.035
Data dispersion, β_d :	0.06	0.30	0.2	0.3
Uncertainty, β_u :	0.4	0.1	0.1	0.1
Total Dispersion, β :	0.4	0.3	0.3	0.3

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Average
Data Relevance Average
Documentation Quality Superior
Rationality Superior
Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No) NO NO NO NO

Repair Costs:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04	1.95E+04	3.45E+04	4.54E+04			
Best fit mean:	2.09E+04			3.31E+04			3.96E+04			3.31E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 0.39			4.14E+04 0.31			4.92E+04 0.29			4.14E+04 0.31					
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01	1.72E+01	3.04E+01	4.01E+01			
Best fit mean:	1.89E+01			3.04E+01			3.62E+01			3.04E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.27E+01 0.46			3.65E+01 0.39			4.34E+01 0.39			3.65E+01 0.39					
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Casualty-affected Planar Area (sf) per Normative Unit:															
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			NO			YES			NO					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50			0% 0.00					

Comments: Note: DS4 is a copy of DS2 to create a mutually exclusive compliment to DS3.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: 2011-08-24 Changed DS4 beta from 0.4 to 0.3 to avoid negative probability.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1041.023b

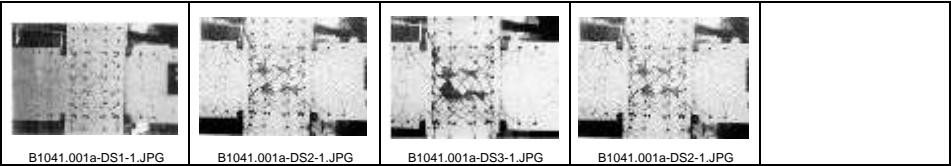
ACI 318 IMF, Conc Col & Bm = 36" x 36", Beam both sides
ACI318 IMF, joint shear damage or failure, beam or column flexure-shear response. Meets the following requirements: (1) Column Pu < 0.3Agfc. Costing is on a per joint basis.

Line 119

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Sequential	Sequential	Mutually Exclusive	Mutually Exclusive	
DS Hierarchy	Seq(DS1,DS2,MutEx(DS3,DS4))				
Descriptions	Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00	0.40	0.60
Fragility Parameters				
Median Demand, θ :	0.02	0.025	0.035	0.035
Data dispersion, β_d :	0.06	0.30	0.2	0.3
Uncertainty, β_u :	0.4	0.1	0.1	0.1
Total Dispersion, β :	0.4	0.3	0.3	0.3
Correlation (Yes / No)	NO			
Directionality (Yes / No)	YES			
Quality Ratings				
Data Quality	Average			
Data Relevance	Average			
Documentation Quality	Superior			
Rationality	Superior			
Consequence Functions				
Repair Description	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.	Remove furnishings, ceilings and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO NO

Repair Costs:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04	1.95E+04	3.45E+04	4.54E+04			
Best fit mean:	2.09E+04			3.31E+04			3.96E+04			3.31E+04					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 0.39			4.14E+04 0.31			4.92E+04 0.29			4.14E+04 0.31					
CV or beta (Min Qty, Max Qty)	0.39			0.31			0.29			0.31					
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01	1.72E+01	3.04E+01	4.01E+01			
Best fit mean:	1.89E+01			3.04E+01			3.62E+01			3.04E+01					
Best Fit Distribution:	Normal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00			5.00 20.00					
Average Repair Time (Min Qty, Max Qty)	2.27E+01 0.46			3.65E+01 0.39			4.34E+01 0.39			3.65E+01 0.39					
CV or beta (Min Qty, Max Qty)	0.46			0.39			0.39			0.39					
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			NO			YES			NO					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50			0% 0.00					

Comments: Note: DS4 is a copy of DS2 to create a mutually exclusive compliment to DS3.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: 2011-08-24 Changed DS4 beta from 0.4 to 0.3 to avoid negative probability.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1041.031a

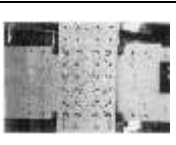
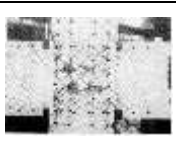
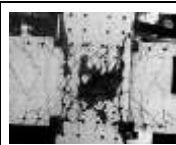
ACI 318 OMF with weak joints and beam flexural response, Conc Col & Bm = 24" x 24", Beam one side

ACI318 OMF, joint shear failure, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) Beam Vn > Veq, (3) Column Vn > Veq. Costing is on a per joint basis.

Line 120

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Beams or joints exhibit residual crack widths >0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	B1041.031a-DS1-1.JPG	B1041.031a-DS2-1.JPG	B1041.031a-DS3-1.JPG		

Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0175	0.0225	0.0322		
Data dispersion, β_d :	0.2	0.27	0.32		
Uncertainty, β_u :	0.3	0.13	0.15		
Total Dispersion, β :	0.4	0.4	0.4		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Average				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description					

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)	NO	NO	NO		
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Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.85E+04	3.25E+04	4.44E+04	2.30E+04	4.00E+04	5.29E+04						
Best fit mean:	2.09E+04			3.18E+04			3.86E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00						
Average Repair Cost (Min Qty, Max Qty)	2.57E+04		1.71E+04	3.90E+04		2.60E+04	4.80E+04		3.20E+04						
CV or beta (Min Qty, Max Qty)	0.39		0.39	0.32		0.32	0.30		0.30						
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.63E+01	2.87E+01	3.92E+01	2.03E+01	3.53E+01	4.67E+01						
Best fit mean:	1.89E+01			2.87E+01			3.53E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00						
Average Repair Time (Min Qty, Max Qty)	2.27E+01		1.51E+01	3.44E+01		2.29E+01	4.23E+01		2.82E+01						
CV or beta (Min Qty, Max Qty)	0.46		0.46	0.40		0.40	0.39		0.39						
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		20%	0.50							

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Laura Lowes

2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

B1041.031b

NISTIR Name

ACI 318 OMF with weak joints and beam flexural response, Conc Col & Bm = 24" x 24", Beam both sides

Description

ACI318 OMF, joint shear failure, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) Beam Vn > Veq, (3) Column Vn > Veq. Costing is on a per joint basis.

Line 121

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio Unit less

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

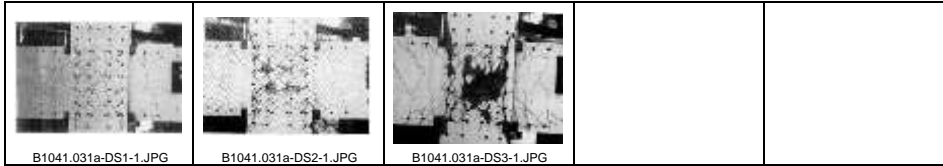
Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0175

0.0225

0.0322

Data dispersion, β_d :

0.2

0.27

0.32

Uncertainty, β_u :

0.3

0.13

0.15

Total Dispersion, β :

0.4

0.4

0.4

Correlation (Yes / No)

NO

Directionality (Yes / No)

YES

Quality Ratings

Data Quality

Average

Data Relevance

Average

Documentation Quality

Superior

Rationality

Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

1.02E+04 2.14E+04 3.11E+04

1.85E+04 3.25E+04 4.44E+04

2.30E+04 4.00E+04 5.29E+04

Best fit mean:

2.09E+04

3.18E+04

3.86E+04

Best Fit Distribution:

Normal

Normal

Normal

Quantity Plateau (Min Qty, Max Qty)

5.00

20.00

5.00

20.00

5.00

20.00

Average Repair Cost (Min Qty, Max Qty)

2.57E+04

1.71E+04

3.90E+04

2.60E+04

4.80E+04

3.20E+04

CV or beta (Min Qty, Max Qty)

0.39

0.39

0.32

0.32

0.30

0.30

Quantity Unit:

Each

Each

Each

Repair Time:

Repair Time by Damage State:

8.98E+00 1.89E+01 2.75E+01

1.63E+01 2.87E+01 3.92E+01

2.03E+01 3.53E+01 4.67E+01

Best fit mean:

1.89E+01

2.87E+01

3.53E+01

Best Fit Distribution:

Normal

Normal

Normal

Quantity Plateau (Min Qty, Max Qty)

5.00

20.00

5.00

20.00

5.00

20.00

Average Repair Time (Min Qty, Max Qty)

2.27E+01

1.51E+01

3.44E+01

2.29E+01

4.23E+01

2.82E+01

CV or beta (Min Qty, Max Qty)

0.46

0.46

0.40

0.40

0.39

0.39

Quantity Unit:

Each

Each

Each

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

NO

NO

NO

Casualty-affected Planar Area (sf) per Normative Unit:

Not Applicable

Not Applicable

Not Applicable

Serious Injury (Median, Dispersion)

0%

0.00

0%

0.00

0%

0.00

Loss of Life (Median, Dispersion)

0%

0.00

0%

0.00

0%

0.00

Post-event Tagging Flag:

NO

NO

YES

Unsafe Placard Trigger (Median, Dispersion)

0%

0.00

0%

0.00

20%

0.50

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Laura Lowes

Revisions:

2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1041.032a

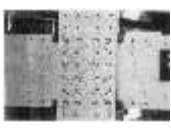
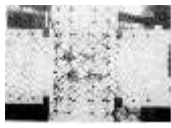

ACI 318 OMF with weak joints and beam flexural response, Conc Col & Bm = 24" x 36", Beam one side

ACI318 OMF, joint shear failure, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) Beam Vn > Veq, (3) Column Vn > Veq. Costing is on a per joint basis.

Line 122

Construction Quality:	Not Specified		
Seismic Installation Conditions:	Not Specified		
Fragility Unit of Measure:	EA 1		
Demand Parameter (unit):	Story Drift Ratio	Unit less	
Number of Damage States:	3		
Damage State:	DS1	DS2	DS3
Type of Damage State:	Sequential	Sequential	Sequential
DS Hierarchy	Seq(DS1,DS2,DS3)		
Descriptions	Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	B1041.031a-DS1-1.JPG	B1041.031a-DS2-1.JPG	B1041.031a-DS3-1.JPG		

Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0175	0.0225	0.0322		
Data dispersion, β_d :	0.2	0.27	0.32		
Uncertainty, β_u :	0.3	0.13	0.15		
Total Dispersion, β :	0.4	0.4	0.4		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Average				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.				

Repair Description	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).
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Long Lead Time (Yes / No)	NO	NO	NO		
Repair Costs:	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}
Repair Cost by Damage State:	1.02E+04 2.14E+04 3.11E+04	1.95E+04 3.45E+04 4.54E+04	2.40E+04 4.10E+04 5.39E+04		
Best fit mean:	2.09E+04	3.31E+04	3.96E+04		
Best Fit Distribution:	Normal	Normal	Normal		
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00	5.00 20.00	5.00 20.00		
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 0.39 1.71E+04 0.39	4.14E+04 0.31 2.76E+04 0.31	4.92E+04 0.29 3.28E+04 0.29		
CV or beta (Min Qty, Max Qty)					
Quantity Unit:	Each	Each	Each		
Repair Time:	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}
Repair Time by Damage State:	8.98E+00 1.89E+01 2.75E+01	1.72E+01 3.04E+01 4.01E+01	2.12E+01 3.62E+01 4.76E+01		
Best fit mean:	1.89E+01	3.04E+01	3.62E+01		
Best Fit Distribution:	Normal	Normal	Normal		
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00	5.00 20.00	5.00 20.00		
Average Repair Time (Min Qty, Max Qty)	2.27E+01 0.46 1.51E+01 0.46	3.65E+01 0.39 2.43E+01 0.39	4.34E+01 0.39 2.89E+01 0.39		
CV or beta (Min Qty, Max Qty)					
Quantity Unit:	Each	Each	Each		
LifeSafety Hazard:					
Potential non-collapse casualties? (Yes / No)	NO	NO	NO		
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable	Not Applicable	Not Applicable		
Serious Injury (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00		
Loss of Life (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00		
Post-event Tagging Flag:	NO	NO	YES		
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00	0% 0.00	20% 0.50		

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Laura Lowes

2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.

Root Cost Multiplier: 1

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

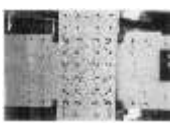
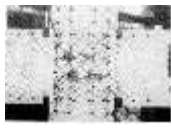

B1041.033a

ACI 318 OMF with weak joints and beam flexural response, Conc Col & Bm = 36" x 36", Beam one side

ACI318 OMF, joint shear failure, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) Beam Vn > Veq, (3) Column Vn > Veq. Costing is on a per joint basis.

Line 124

Construction Quality:	Not Specified			<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>			
Seismic Installation Conditions:	Not Specified						
Fragility Unit of Measure:	EA 1						
Demand Parameter (unit):	Story Drift Ratio		Unit less				
Number of Damage States:	3						
Damage State:	DS1	DS2		DS3			
Type of Damage State:	Sequential		Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)						
Descriptions	Beams or joints exhibit residual crack widths >0.06 in. No significant spalling. No fracture or buckling of reinforcing.		Beams or joints exhibit residual crack widths >0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.		Beams or joints exhibit residual crack widths >0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.		

Illustrations					
					
	B1041.031a-DS1-1.JPG	B1041.031a-DS2-1.JPG	B1041.031a-DS3-1.JPG		
	1.00	1.00	1.00		

Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0175	0.0225	0.0322		
Data dispersion, β_d :	0.2	0.27			
Uncertainty, β_u :	0.3	0.13	0.15		
Total Dispersion, β :	0.4	0.4	0.4		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Average				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Remove furnishings, ceilings and	Remove furnishings, ceilings and	Remove furnishings, ceilings and		

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)	NO			NO			NO														
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀						
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04												
Best fit mean:	2.09E+04			3.31E+04			3.96E+04														
Best Fit Distribution:	Normal			Normal			Normal														
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00												
Average Repair Cost (Min Qty, Max Qty)	2.57E+04		1.71E+04	4.14E+04		2.76E+04	4.92E+04		3.28E+04												
CV or beta (Min Qty, Max Qty)	0.39		0.39	0.31		0.31	0.29		0.29												
Quantity Unit:	Each			Each			Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀						
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01												
Best fit mean:	1.89E+01			3.04E+01			3.62E+01														
Best Fit Distribution:	Normal			Normal			Normal														
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00												
Average Repair Time (Min Qty, Max Qty)	2.27E+01		1.51E+01	3.65E+01		2.43E+01	4.34E+01		2.89E+01												
CV or beta (Min Qty, Max Qty)	0.46		0.46	0.39		0.39	0.39		0.39												
Quantity Unit:	Each			Each			Each														
LifeSafety Hazard:																					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00													
Post-event Tagging Flag:	NO			NO			YES														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		20%	0.50													
Comments:	None																				
Date Created:	Not Given																				
Approved (YES / NO)?	By User																				
Official (YES / NO) ?	By User																				
Author:	Laura Lowes																				
Revisions:	2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.																				

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

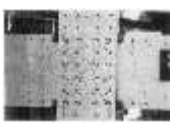
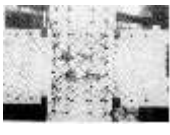

B1041.033b

ACI 318 OMF with weak joints and beam flexural response, Conc Col & Bm = 36" x 36", Beam both sides

ACI318 OMF, joint shear failure, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) Beam Vn > Veq, (3) Column Vn > Veq. Costing is on a per joint basis.

Line 125

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Beams or joints exhibit residual crack widths >0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.		

Illustrations					
	B1041.031a-DS1-1.JPG	B1041.031a-DS2-1.JPG	B1041.031a-DS3-1.JPG		

Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0175	0.0225	0.0322		
Data dispersion, β_d :	0.2	0.27	0.32		
Uncertainty, β_u :	0.3	0.13	0.15		
Total Dispersion, β :	0.4	0.4	0.4		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Average				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a min one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).		

Long Lead Time (Yes / No)	NO			NO			NO														
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀						
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04												
Best fit mean:	2.09E+04			3.31E+04			3.96E+04														
Best Fit Distribution:	Normal			Normal			Normal														
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00												
Average Repair Cost (Min Qty, Max Qty)	2.57E+04		1.71E+04	4.14E+04		2.76E+04	4.92E+04		3.28E+04												
CV or beta (Min Qty, Max Qty)	0.39		0.39	0.31		0.31	0.29		0.29												
Quantity Unit:	Each			Each			Each														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀						
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01												
Best fit mean:	1.89E+01			3.04E+01			3.62E+01														
Best Fit Distribution:	Normal			Normal			Normal														
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00												
Average Repair Time (Min Qty, Max Qty)	2.27E+01		1.51E+01	3.65E+01		2.43E+01	4.34E+01		2.89E+01												
CV or beta (Min Qty, Max Qty)	0.46		0.46	0.39		0.39	0.39		0.39												
Quantity Unit:	Each			Each			Each														
LifeSafety Hazard:																					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00													
Post-event Tagging Flag:	NO			NO			YES														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		20%	0.50													
Comments:	None																				
Date Created:	Not Given																				
Approved (YES / NO)?	By User																				
Official (YES / NO) ?	By User																				
Author:	Laura Lowes																				
Revisions:	2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.																				

Root Cost Multiplier: 1

Root Cost Multiplier: 1

ACI318 OMF, joint shear failure, beam flexural response. Meets the following requirements: (1) $\text{Sum } M_{\text{col}} / \text{Sum } M_{\text{beam}} > 1.2$, (2) $\text{Beam } V_n > V_{eq}$, (3) $\text{Column } V_n > V_{eq}$. Costing is on a per joint basis.

Descriptions	Concrete Cracking: beams, joints or possibly residual concrete crack widths exceed 0.06 in. (1.5 mm). Column exhibit residual crack widths that require epoxy injection.	Concrete Spalling: slabs, beams, joints or possibly columns exhibit spalling of cover concrete that exposes transverse but not longitudinal reinforcing steel. Spalling of cover concrete possibly exposing transverse reinforcement.	Concrete Crushing: slabs, beams or joints. Spalling of beam, column or joint cover concrete exposes longitudinal reinforcement OR strength loss initiates in laboratory testing. exhibit concrete spalling that exposes longitudinal steel or crushing of core concrete.
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none	none	none		
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	None	None	None
Damage State Probability:	1.00	1.00	1.00

Parameter	0.00	0.00	0.00
Fragility Parameters			
Median Demand, θ :	0.015	0.0175	0.02
Data dispersion, β_d :	Not Specified	0.28	0.18
Uncertainty, β_u :	0.4	0.15	0.35
Total Dispersion, δ :	0.4	0.4	0.4

Correlation (Yes / No)	NO
Directionality (Yes / No)	YES

Quality Ratings	
Data Quality	Average
Data Relevance	Average
Documentation Quality	Superior
Rationality	Superior

Consequence Functions	Repair Description	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).
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Long Lead Time (Yes / No)	NO	NO	NO
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Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:		2.09E+04			3.31E+04			3.96E+04							
Best Fit Distribution:		Normal			Normal			Normal							
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00						
Average Repair Cost (Min Qty, Max Qty)	2.57E+04		1.71E+04	4.14E+04		2.76E+04	4.92E+04		3.28E+04						
CV or beta (Min Qty, Max Qty)	0.39		0.39	0.31		0.31	0.29		0.29						

Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00	20.00		5.00	20.00		5.00	20.00							
Average Repair Time (Min Qty, Max Qty)	2.27E+01	1.51E+01		3.65E+01	2.43E+01		4.34E+01	2.89E+01							
CV or beta (Min Qty, Max Qty)	0.46	0.46		0.39	0.39		0.39	0.39							
Quantity Unit:	Each			Each			Each								

LifeSafety Hazard: Potential non-collapse casualties? (Yes / No)	NO		NO		NO			
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable		Not Applicable		Not Applicable			
Serious Injury (Median, Dispersion)	0%	0.00	0%	0.00	0%	0.00		
Loss of Life (Median, Dispersion)	0%	0.00	0%	0.00	0%	0.00		
Post-event Tagging Flag: Unsafe Placard Trigger (Median, Dispersion)	NO		NO		YES			
	0%	0.00	0%	0.00	20%	0.50		

Dispersion(s)	0%	0.00	0%	0.00	20%	0.30		
Comments:	None							
Date Created:	Not Given							Root Cost Multiplier: 1
Approved (YES / NO)?	By User							
Official (YES / NO) ?	By User							
Author:	Laura Lowes							
Revisions:	2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.							

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1041.043b

ACI 318 OMF with weak joints and column flexural response, Conc Col & Bm = 36" x 36", Beam both sides

ACI318 OMF, joint shear failure, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) Beam Vn > Veq, (3) Column Vn > Veq. Costing is on a per joint basis.

Line 131

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>	
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	EA 1					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	3					
Damage State:	DS1	DS2	DS3			
Type of Damage State:	Sequential		Sequential		Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)					
Descriptions	Concrete Cracking: beams, joints or possibly Residual concrete crack widths exceed 0.06 in. (1.5 mm). Column exhibit residual crack widths that require epoxy injection.	Concrete Spalling: slabs, beams, joints or possibly columns exhibit spalling of cover concrete that exposes transverse but not longitudinal reinforcing steel. Spalling of cover concrete possibly exposing transverse reinforcement.	Concrete Crushing: slabs, beams or joints. Spalling of beam, column or joint cover concrete exposes longitudinal reinforcement OR strength loss initiates in laboratory testing. exhibit concrete spalling that exposes longitudinal steel or crushing of core concrete.			

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.015	0.0175	0.02		
Data dispersion, β_d :	Not Specified	0.28	0.18		
Uncertainty, β_u :	0.4	0.15	0.35		
Total Dispersion, β :	0.4	0.4	0.4		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Average				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description					

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00						
Average Repair Cost (Min Qty, Max Qty)	2.57E+04		1.71E+04	4.14E+04		2.76E+04	4.92E+04		3.28E+04						
CV or beta (Min Qty, Max Qty)	0.39		0.39	0.31		0.31	0.29		0.29						
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00						
Average Repair Time (Min Qty, Max Qty)	2.27E+01		1.51E+01	3.65E+01		2.43E+01	4.34E+01		2.89E+01						
CV or beta (Min Qty, Max Qty)	0.46		0.46	0.39		0.39	0.39		0.39						
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		20%	0.50							

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1041.051a
NISTIR Name ACI 318 OMF with weak beams and weak joints, beam flexural or shear response, Conc Col & Bm = 24" x 24", Beam one side
Description ACI318 OMF, beam flexure-shear or shear failure, beam flexural response. Meets the following requirements: (1) Beam Vn < Veq. Costing is on a per joint basis.

Line 132

Construction Quality:	Not Specified		
Seismic Installation Conditions:	Not Specified		
Fragility Unit of Measure:	EA 1		
Demand Parameter (unit):	Story Drift Ratio	Unit less	
Number of Damage States:	3		
Damage State:	DS1	DS2	DS3
Type of Damage State:	Sequential	Sequential	Sequential
DS Hierarchy	Seq(DS1,DS2,DS3)		
Descriptions	Beams exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams exhibit residual crack widths > 0.06 in. Spalling of beam cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of beam core concrete may occur. Fracture or buckling of reinf. requiring replacement may occur.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0175	0.02	0.03		
Data dispersion, β_d :	Not Specified	0.27	0.32		
Uncertainty, β_u :	0.4	0.15	0.15		
Total Dispersion, β :	0.4	0.4	0.4		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Average				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.				

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.85E+04	3.25E+04	4.44E+04	2.30E+04	4.00E+04	5.29E+04						
Best fit mean:	2.09E+04			3.18E+04			3.86E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00						
Average Repair Cost (Min Qty, Max Qty)	2.57E+04		1.71E+04	3.90E+04		2.60E+04	4.80E+04		3.20E+04						
CV or beta (Min Qty, Max Qty)	0.39		0.39	0.32		0.32	0.30		0.30						
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.63E+01	2.87E+01	3.92E+01	2.03E+01	3.53E+01	4.67E+01						
Best fit mean:	1.89E+01			2.87E+01			3.53E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00						
Average Repair Time (Min Qty, Max Qty)	2.27E+01		1.51E+01	3.44E+01		2.29E+01	4.23E+01		2.82E+01						
CV or beta (Min Qty, Max Qty)	0.46		0.46	0.40		0.40	0.39		0.39						
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		20%	0.50							

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1041.051b

ACI 318 OMF with weak beams and weak joints, beam flexural or shear response, Conc Col & Bm = 24" x 24", Beam both sides
ACI318 OMF, beam flexure-shear or shear failure, beam flexural response. Meets the following requirements: (1) Beam Vn < Veq. Costing is on a per joint basis.

Line 133

Construction Quality:	Not Specified		
Seismic Installation Conditions:	Not Specified		
Fragility Unit of Measure:	EA 1		
Demand Parameter (unit):	Story Drift Ratio	Unit less	
Number of Damage States:	3		
Damage State:	DS1	DS2	DS3
Type of Damage State:	Sequential	Sequential	Sequential
DS Hierarchy	Seq(DS1,DS2,DS3)		
Descriptions	Beams exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams exhibit residual crack widths > 0.06 in. Spalling of beam cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of beam core concrete may occur. Fracture or buckling of reinf. requiring replacement may occur.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
B1041.051a-DS1-1.JPG	B1041.051a-DS2-1.JPG	B1041.051a-DS3-1.JPG		

Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0175	0.02	0.03		
Data dispersion, β_d :	Not Specified	0.27	0.32		
Uncertainty, β_u :	0.4	0.15	0.15		
Total Dispersion, β :	0.4	0.4	0.4		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Average				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.				

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.85E+04	3.25E+04	4.44E+04	2.30E+04	4.00E+04	5.29E+04						
Best fit mean:	2.09E+04			3.18E+04			3.86E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00						
Average Repair Cost (Min Qty, Max Qty)	2.57E+04		1.71E+04	3.90E+04		2.60E+04	4.80E+04		3.20E+04						
CV or beta (Min Qty, Max Qty)	0.39		0.39	0.32		0.32	0.30		0.30						
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.63E+01	2.87E+01	3.92E+01	2.03E+01	3.53E+01	4.67E+01						
Best fit mean:	1.89E+01			2.87E+01			3.53E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00						
Average Repair Time (Min Qty, Max Qty)	2.27E+01		1.51E+01	3.44E+01		2.29E+01	4.23E+01		2.82E+01						
CV or beta (Min Qty, Max Qty)	0.46		0.46	0.40		0.40	0.39		0.39						
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		20%	0.50							

Root Cost Multiplier: 1

Uso 134

ACI 318 OMF beam flexure-shear or shear failure, beam flexural response. Meets the following requirements: (1) Beam $V_n < V_{eq}$. Costing is on a per joint basis.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Type of Damage State: DS Hierarchy Descriptions	Sequential	Sequential	Sequential
	Seq(DS1,DS2,DS3)		
	Beams exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcing. No fracture or buckling of reinforcing.	Beams exhibit residual crack widths > 0.06 in. Spalling of beam cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of beam core concrete may occur. Fracture or buckling of reinf. requiring replacement may occur.

				
R1041_051a-DS1-1.JPG	R1041_051a-DS2-1.JPG	R1041_051a-DS3-1.JPG		

Total Dispersion, s^2	0.4
Correlation (Yes / No)	NO
Directionality (Yes / No)	YES

Quality Ratings	
Data Quality	Average
Data Relevance	Average
Documentation Quality	Superior
Rationality	Superior

Rationality	Consequence Functions	Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).
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Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00						
Average Repair Cost (Min Qty, Max Qty)	2.57E+04		1.71E+04	4.14E+04		2.76E+04	4.92E+04		3.28E+04						
CV or beta (Min Qty, Max Qty)	0.39		0.39	0.31		0.31	0.29		0.29						

Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00						
Average Repair Time (Min Qty, Max Qty)	2.27E+01		1.51E+01	3.65E+01		2.43E+01	4.34E+01		2.89E+01						
CV or beta (Min Qty, Max Qty)	0.46		0.46	0.39		0.39	0.39		0.39						

	Ea01		Ea01		Ea01		
LifeSafety Hazard: Potential non-collapse casualties? (Yes / No)	NO		NO		NO		
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable		Not Applicable		Not Applicable		
Serious Injury (Median, Dispersion)	0%	0.00	0%	0.00	0%	0.00	
Loss of Life (Median, Dispersion)	0%	0.00	0%	0.00	0%	0.00	
Post-event Tagging Flag: Unsafe Placard Trigger (Median, Dispersion)	NO		NO		YES		
	0%	0.00	0%	0.00	20%	0.50	

Dispersion:	0%	0.00	0%	0.00	20%	0.30
Comments:	None					
Date Created:	Not Given					
Approved (YES / NO)?	By User					
Official (YES / NO) ?	By User					
Author:	Laura Lowes					
Revisions:	2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.					

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1041.052b

ACI 318 OMF with weak beams and weak joints, beam flexural or shear response, Conc Col & Bm = 24" x 36", Beam both sides
ACI318 OMF, beam flexure-shear or shear failure, beam flexural response. Meets the following requirements: (1) Beam Vn < Veq. Costing is on a per joint basis.

Line 135

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Beams exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams exhibit residual crack widths > 0.06 in. Spalling of beam cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of beam core concrete may occur. Fracture or buckling of reinf. requiring replacement may occur.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0175	0.02	0.03		
Data dispersion, β_d :	Not Specified	0.27	0.32		
Uncertainty, β_u :	0.4	0.15	0.15		
Total Dispersion, β :	0.4	0.4	0.4		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Average				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).		

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	2.57E+04			4.14E+04			4.92E+04			3.28E+04					
CV or beta (Min Qty, Max Qty)	0.39			0.31			0.29			0.29					
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	2.27E+01			3.65E+01			4.34E+01			2.89E+01					
CV or beta (Min Qty, Max Qty)	0.46			0.39			0.39			0.39					
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50								

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1041.053a

ACI 318 OMF with weak beams and weak joints, beam flexural or shear response, Conc Col & Bm = 36" x 36", Beam one side

ACI318 OMF, beam flexure-shear or shear failure, beam flexural response. Meets the following requirements: (1) Beam Vn < Veq. Costing is on a per joint basis.

Construction Quality:

Not Specified

Seismic Installation Conditions:

EA 1

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Beams exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.

Beams exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Beams exhibit residual crack widths > 0.06 in. Spalling of beam cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of beam core concrete may occur. Fracture or buckling of reinf. requiring replacement may occur.

Quantity Rounding

Round Qty?

YES


Allow sum by floor or building?


NO


Demand Location (floor above?)

No

Illustrations







Damage State Probability:

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0175

0.02

0.03

Data dispersion, β_d :

Not Specified

0.27

0.32

Uncertainty, β_u :

0.4

0.15

0.15

Total Dispersion, β :

0.4

0.4

0.4

Correlation (Yes / No)

NO

Directionality (Yes / No)

YES

Quality Ratings

Data Quality

Average

Data Relevance

Average

Documentation Quality

Superior

Rationality

Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

P₁₀

P₅₀

P₉₀

1.02E+04

2.14E+04

3.11E+04

Best fit mean:

2.09E+04

3.31E+04

3.96E+04

Best Fit Distribution:

Normal

Normal

Normal

Quantity Plateau

5.00

20.00

20.00

(Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

2.57E+04

1.71E+04

4.14E+04

CV or beta (Min Qty, Max Qty)

0.39

0.39

0.31

Quantity Unit:

Each

Each

Each

Repair Time:

Repair Time by Damage State:

P₁₀

P₅₀

P₉₀

8.98E+00

1.89E+01

2.75E+01

Best fit mean:

1.89E+01

3.04E+01

3.62E+01

Best Fit Distribution:

Normal

Normal

Normal

Quantity Plateau

5.00

20.00

20.00

(Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

2.27E+01

1.51E+01

3.65E+01

CV or beta (Min Qty, Max Qty)

0.46

0.46

0.39

Quantity Unit:

Each

Each

Each

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

NO

NO

NO

Casualty-affected Planar Area (sf) per Normative Unit:

Not Applicable

Not Applicable

Not Applicable

Serious Injury (Median, Dispersion)

0%

0.00

0%

0.00

0%

0.00

Loss of Life (Median, Dispersion)

0%

0.00

0%

0.00

0%

0.00

Post-event Tagging Flag:

NO

NO

YES

Unsafe Placard Trigger (Median, Dispersion)

0%

0.00

0%

0.00

20%

0.50

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Laura Lowes

Revisions:

2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1041.053b

ACI 318 OMF with weak beams and weak joints, beam flexural or shear response, Conc Col & Bm = 36" x 36", Beam both sides
ACI318 OMF, beam flexure-shear or shear failure, beam flexural response. Meets the following requirements: (1) Beam Vn < Veq. Costing is on a per joint basis.

Line 137

Construction Quality:	Not Specified		
Seismic Installation Conditions:	Not Specified		
Fragility Unit of Measure:	EA 1		
Demand Parameter (unit):	Story Drift Ratio	Unit less	
Number of Damage States:	3		
Damage State:	DS1	DS2	DS3
Type of Damage State:	Sequential	Sequential	Sequential
DS Hierarchy	Seq(DS1,DS2,DS3)		
Descriptions	Beams exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams exhibit residual crack widths > 0.06 in. Spalling of beam cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of beam core concrete may occur. Fracture or buckling of reinf. requiring replacement may occur.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
B1041.051a-DS1-1.JPG	B1041.051a-DS2-1.JPG	B1041.051a-DS3-1.JPG		

Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0175	0.02	0.03		
Data dispersion, β_d :	Not Specified	0.27	0.32		
Uncertainty, β_u :	0.4	0.15	0.15		
Total Dispersion, β :	0.4	0.4	0.4		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Average				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).		

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00						
Average Repair Cost (Min Qty, Max Qty)	2.57E+04		1.71E+04	4.14E+04		2.76E+04	4.92E+04		3.28E+04						
CV or beta (Min Qty, Max Qty)	0.39		0.39	0.31		0.31	0.29		0.29						
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00						
Average Repair Time (Min Qty, Max Qty)	2.27E+01		1.51E+01	3.65E+01		2.43E+01	4.34E+01		2.89E+01						
CV or beta (Min Qty, Max Qty)	0.46		0.46	0.39		0.39	0.39		0.39						
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		20%	0.50							
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Laura Lowes														
Revisions:	2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1041.061a

ACI 318 OMF with weak columns, Conc Col & Bm = 24" x 24", Beam one side

ACI318 OMF, column shear or flexural-shear failure, column flexural response. Meets the following requirements: (1) Column Pu < 0.6Agf'c, (2) Column Vn < Veq. Costing is on a per joint basis.

Line 138

Construction Quality:	Not Specified			<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Story Drift Ratio	Unit less		
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Columns exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinf.	Columns exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes column transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Columns exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinf. requiring replacement may occur.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	B1041.051a-DS1-1.JPG	B1041.051a-DS2-1.JPG	B1041.051a-DS3-1.JPG		
	1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.015	0.0175	0.02		
Data dispersion, β_d :	Not Specified	0.27	0.18		
Uncertainty, β_u :	0.4	0.15	0.35		
Total Dispersion, β :	0.4	0.4	0.4		

Correlation (Yes / No) NO
Directionality (Yes / No) YES
Quality Ratings
Data Quality Average
Data Relevance Average
Documentation Quality Superior
Rationality Superior
Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)	NO	NO	NO		
Repair Costs:	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀
Repair Cost by Damage State:	1.02E+04 2.14E+04 3.11E+04	1.85E+04 3.25E+04 4.44E+04	2.30E+04 4.00E+04 5.29E+04		
Best fit mean:	2.09E+04	3.18E+04	3.86E+04		
Best Fit Distribution:	Normal	Normal	Normal		
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00	5.00 20.00	5.00 20.00		
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 1.71E+04	3.90E+04 2.60E+04	4.80E+04 3.20E+04		
CV or beta (Min Qty, Max Qty)	0.39 0.39	0.32 0.32	0.30 0.30		
Quantity Unit:	Each	Each	Each		
Repair Time:	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀
Repair Time by Damage State:	8.98E+00 1.89E+01 2.75E+01	1.63E+01 2.87E+01 3.92E+01	2.03E+01 3.53E+01 4.67E+01		
Best fit mean:	1.89E+01	2.87E+01	3.53E+01		
Best Fit Distribution:	Normal	Normal	Normal		
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00	5.00 20.00	5.00 20.00		
Average Repair Time (Min Qty, Max Qty)	2.27E+01 1.51E+01	3.44E+01 2.29E+01	4.23E+01 2.82E+01		
CV or beta (Min Qty, Max Qty)	0.46 0.46	0.40 0.40	0.39 0.39		
Quantity Unit:	Each	Each	Each		
LifeSafety Hazard:					
Potential non-collapse casualties? (Yes / No)	NO	NO	NO		
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable	Not Applicable	Not Applicable		
Serious Injury (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00		
Loss of Life (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00		
Post-event Tagging Flag:	NO	NO	YES		
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00	0% 0.00	10% 0.50		

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Laura Lowes

2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1041.061b



ACI 318 OMF with weak columns, Conc Col & Bm = 24" x 24", Beam both sides

ACI318 OMF, column shear or flexural-shear failure, column flexural response. Meets the following requirements: (1) Column Pu < 0.6Agf'c, (2) Column Vn < Veq. Costing is on a per joint basis.

Line 139

Construction Quality:	Not Specified			<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Story Drift Ratio	Unit less		
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Columns exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinf.	Columns exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes column transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Columns exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinf. requiring replacement may occur.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	B1041.051a-DS1-1.JPG	B1041.051a-DS2-1.JPG	B1041.051a-DS3-1.JPG		
	1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.015	0.0175	0.02		
Data dispersion, β_d :	Not Specified	0.27	0.18		
Uncertainty, β_u :	0.4	0.15	0.35		
Total Dispersion, β :	0.4	0.4	0.4		

Correlation (Yes / No) NO
Directionality (Yes / No) YES
Quality Ratings
Data Quality Average
Data Relevance Average
Documentation Quality Superior
Rationality Superior
Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)	NO	NO	NO		
Repair Costs:	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}
Repair Cost by Damage State:	1.02E+04 2.14E+04 3.11E+04	1.85E+04 3.25E+04 4.44E+04	2.30E+04 4.00E+04 5.29E+04		
Best fit mean:	2.09E+04	3.18E+04	3.86E+04		
Best Fit Distribution:	Normal	Normal	Normal		
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00	5.00 20.00	5.00 20.00		
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 1.71E+04	3.90E+04 2.60E+04	4.80E+04 3.20E+04		
CV or beta (Min Qty, Max Qty)	0.39 0.39	0.32 0.32	0.30 0.30		
Quantity Unit:	Each	Each	Each		
Repair Time:	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}
Repair Time by Damage State:	8.98E+00 1.89E+01 2.75E+01	1.63E+01 2.87E+01 3.92E+01	2.03E+01 3.53E+01 4.67E+01		
Best fit mean:	1.89E+01	2.87E+01	3.53E+01		
Best Fit Distribution:	Normal	Normal	Normal		
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00	5.00 20.00	5.00 20.00		
Average Repair Time (Min Qty, Max Qty)	2.27E+01 1.51E+01	3.44E+01 2.29E+01	4.23E+01 2.82E+01		
CV or beta (Min Qty, Max Qty)	0.46 0.46	0.40 0.40	0.39 0.39		
Quantity Unit:	Each	Each	Each		
LifeSafety Hazard:					
Potential non-collapse casualties? (Yes / No)	NO	NO	NO		
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable	Not Applicable	Not Applicable		
Serious Injury (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00		
Loss of Life (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00		
Post-event Tagging Flag:	NO	NO	YES		
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00	0% 0.00	10% 0.50		
Comments:	None				
Date Created:	Not Given				
Approved (YES / NO)?	By User				
Official (YES / NO) ?	By User				
Author:	Laura Lowes				
Revisions:	2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.				

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1041.062a

ACI 318 OMF with weak columns, Conc Col & Bm = 24" x 36", Beam one side

ACI318 OMF, column shear or flexural-shear failure, column flexural response. Meets the following requirements: (1) Column Pu < 0.6Agf'c, (2) Column Vn < Veq. Costing is on a per joint basis.

Line 140

Construction Quality:	Not Specified			<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Story Drift Ratio	Unit less		
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Columns exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinf.	Columns exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes column transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Columns exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinf. requiring replacement may occur.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	B1041.051a-DS1-1.JPG	B1041.051a-DS2-1.JPG	B1041.051a-DS3-1.JPG		
	1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.015	0.0175	0.02		
Data dispersion, β_d :	Not Specified	0.27	0.18		
Uncertainty, β_u :	0.4	0.15	0.35		
Total Dispersion, β :	0.4	0.4	0.4		

Correlation (Yes / No)
Directionality (Yes / No)
Quality Ratings
Data Quality
Data Relevance
Documentation Quality
Rationality
Consequence Functions
Repair Description

NO
YES
Average
Average
Superior
Superior
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)	NO			NO			NO								
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00						
Average Repair Cost (Min Qty, Max Qty)	2.57E+04		1.71E+04	4.14E+04		2.76E+04	4.92E+04		3.28E+04						
CV or beta (Min Qty, Max Qty)	0.39		0.39	0.31		0.31	0.29		0.29						
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00						
Average Repair Time (Min Qty, Max Qty)	2.27E+01		1.51E+01	3.65E+01		2.43E+01	4.34E+01		2.89E+01						
CV or beta (Min Qty, Max Qty)	0.46		0.46	0.39		0.39	0.39		0.39						
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		10%	0.50							

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1041.062b

ACI 318 OMF with weak columns, Conc Col & Bm = 24" x 36", Beam both sides

ACI318 OMF, column shear or flexural-shear failure, column flexural response. Meets the following requirements: (1) Column Pu < 0.6Agf'c, (2) Column Vn < Veq. Costing is on a per joint basis.

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Columns exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinf.

Columns exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes column transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

Columns exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinf. requiring replacement may occur.

Quantity Rounding

Round Qty?

YES


Allow sum by floor or building?


NO


Demand Location (floor above?)

No

Illustrations







Damage State Probability:

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.015

0.0175

0.02

Data dispersion, β_d :

Not Specified

0.27

0.18

Uncertainty, β_u :

0.4

0.15

0.35

Total Dispersion, β :

0.4

0.4

0.4

Correlation (Yes / No)

NO

Directionality (Yes / No)

YES

Quality Ratings

Data Quality

Average

Data Relevance

Average

Documentation Quality

Superior

Rationality

Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

1.02E+04

2.14E+04

3.11E+04

1.95E+04

3.45E+04

4.54E+04

2.40E+04

4.10E+04

5.39E+04

Best fit mean:

2.09E+04

3.31E+04

3.96E+04

Best Fit Distribution:

Normal

Normal

Normal

Quantity Plateau (Min Qty, Max Qty)

5.00

20.00

20.00

Average Repair Cost (Min Qty, Max Qty)

2.57E+04

1.71E+04

4.14E+04

2.76E+04

4.92E+04

3.28E+04

CV or beta (Min Qty, Max Qty)

0.39

0.39

0.31

0.31

0.29

0.29

Quantity Unit:

Each

Each

Each

Repair Time:

Repair Time by Damage State:

8.98E+00

1.89E+01

2.75E+01

1.72E+01

3.04E+01

4.01E+01

2.12E+01

3.62E+01

4.76E+01

Best fit mean:

1.89E+01

3.04E+01

3.62E+01

Best Fit Distribution:

Normal

Normal

Normal

Quantity Plateau (Min Qty, Max Qty)

5.00

20.00

20.00

Average Repair Time (Min Qty, Max Qty)

2.27E+01

1.51E+01

3.65E+01

2.43E+01

4.34E+01

2.89E+01

CV or beta (Min Qty, Max Qty)

0.46

0.46

0.39

0.39

0.39

0.39

Quantity Unit:

Each

Each

Each

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

NO

NO

NO

Casualty-affected Planar Area (sf) per Normative Unit:

Not Applicable

Not Applicable

Not Applicable

Serious Injury (Median, Dispersion)

0%

0.00

0%

0.00

0%

0.00

Loss of Life (Median, Dispersion)

0%

0.00

0%

0.00

0%

0.00

Post-event Tagging Flag:

NO

NO

YES

Unsafe Placard Trigger (Median, Dispersion)

0%

0.00

0%

0.00

10%

0.50

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Laura Lowes

Revisions:

2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1041.063a


ACI 318 OMF with weak columns, Conc Col & Bm = 36" x 36", Beam one side

ACI318 OMF, column shear or flexural-shear failure, column flexural response. Meets the following requirements: (1) Column Pu < 0.6Agf'c, (2) Column Vn < Veq. Costing is on a per joint basis.

Line 142

Construction Quality:	Not Specified			<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Story Drift Ratio	Unit less		
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Columns exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinf.	Columns exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes column transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Columns exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinf. requiring replacement may occur.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	B1041.051a-DS1-1.JPG	B1041.051a-DS2-1.JPG	B1041.051a-DS3-1.JPG		
	1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.015	0.0175	0.02		
Data dispersion, β_d :	Not Specified	0.27	0.18		
Uncertainty, β_u :	0.4	0.15	0.35		
Total Dispersion, β :	0.4	0.4	0.4		

Correlation (Yes / No) NO
Directionality (Yes / No) YES
Quality Ratings
Data Quality Average
Data Relevance Average
Documentation Quality Superior
Rationality Superior
Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)	NO			NO			NO								
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	2.57E+04			4.14E+04			4.92E+04			3.28E+04					
CV or beta (Min Qty, Max Qty)	0.39 0.39			0.31 0.31			0.29 0.29								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	2.27E+01			3.65E+01			4.34E+01			2.89E+01					
CV or beta (Min Qty, Max Qty)	0.46 0.46			0.39 0.39			0.39 0.39								
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable								
Casualty-affected Planar Area (sf) per Normative Unit:															
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			10% 0.50								

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1041.063b

ACI 318 OMF with weak columns, Conc Col & Bm = 36" x 36", Beam both sides

ACI318 OMF, column shear or flexural-shear failure, column flexural response. Meets the following requirements: (1) Column Pu < 0.6Agf'c, (2) Column Vn < Veq. Costing is on a per joint basis.

Line 143

Construction Quality:	Not Specified			<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Story Drift Ratio	Unit less		
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Columns exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinf.	Columns exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes column transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Columns exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinf. requiring replacement may occur.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	B1041.051a-DS1-1.JPG	B1041.051a-DS2-1.JPG	B1041.051a-DS3-1.JPG		

Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.015	0.0175	0.02		
Data dispersion, β_d :	Not Specified	0.27	0.18		
Uncertainty, β_u :	0.4	0.15	0.35		
Total Dispersion, β :	0.4	0.4	0.4		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Average				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.				

	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).		
--	---	--	--	--

Long Lead Time (Yes / No)	NO			NO			NO								
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00						
Average Repair Cost (Min Qty, Max Qty)	2.57E+04		1.71E+04	4.14E+04		2.76E+04	4.92E+04		3.28E+04						
CV or beta (Min Qty, Max Qty)	0.39		0.39	0.31		0.31	0.29		0.29						
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00						
Average Repair Time (Min Qty, Max Qty)	2.27E+01		1.51E+01	3.65E+01		2.43E+01	4.34E+01		2.89E+01						
CV or beta (Min Qty, Max Qty)	0.46		0.46	0.39		0.39	0.39		0.39						
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable								
Casualty-affected Planar Area (sf) per Normative Unit:															
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		10%	0.50							
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Laura Lowes														
Revisions:	2011-08-24 Changed DS2 beta from 0.3 to 0.4 to avoid negative probability beyond 1% story drift.														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1041.071a

ACI 318 OMF weak columns w/ high axial load, Conc Col & Bm = 24" x 24", Beam one side

ACI318 OMF, column flexure, flexural-shear, or shear failure at high axial load. Column flexural-shear response. Meets the following requirements: (1) Column Pu > 0.6Agfc, (2) Column Vn < Veq Costing is on a per joint basis.

Line 144

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential


Seq(DS1,DS2)


DS Hierarchy

Concrete Cracking: beams, joints or possibly. Residual concrete crack widths exceed 0.06in. (1.5 mm). Column exhibits residual crack widths that require epoxy injection.

Concrete Crushing: slabs, beams or joints. Spalling of beam, column or joint cover concrete exposes longitudinal reinforcement or strength loss initiates in laboratory testing. Exhibits concrete spalling that exposes longitudinal steel or crushing of core concrete.

Illustrations





B1041.071a-DS1-2.JPG

B1041.071a-DS2-1.JPG

Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0025

0.005

Data dispersion, β_d :

Not Specified

Not Specified

Uncertainty, β_u :

0.4

0.5

Total Dispersion, β :

0.4

0.5

Correlation (Yes / No)

NO

Directionality (Yes / No)

YES

Quality Ratings

Data Quality

Marginal

Data Relevance

Average

Documentation Quality

Superior

Rationality

Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

1.02E+04

2.14E+04

3.11E+04

1.85E+04

3.25E+04

4.44E+04

Best fit mean:

2.09E+04

3.18E+04

Best Fit Distribution:

Normal

Normal

Quantity Plateau (Min Qty, Max Qty)

5.00

20.00

5.00

20.00

Average Repair Cost (Min Qty, Max Qty)

2.57E+04

1.71E+04

3.90E+04

2.60E+04

CV or beta (Min Qty, Max Qty)

0.39

0.39

0.32

0.32

Quantity Unit:

Each

Each

Repair Time:

Repair Time by Damage State:

8.98E+00

1.89E+01

2.75E+01

1.63E+01

2.87E+01

3.92E+01

Best fit mean:

1.89E+01

2.87E+01

Best Fit Distribution:

Normal

Normal

Quantity Plateau (Min Qty, Max Qty)

5.00

20.00

5.00

20.00

Average Repair Time (Min Qty, Max Qty)

2.27E+01

1.51E+01

3.44E+01

2.29E+01

CV or beta (Min Qty, Max Qty)

0.46

0.46

0.40

0.40

Quantity Unit:

Each

Each

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

NO

NO

Casualty-affected Planar Area (sf) per Normative Unit:

Not Applicable

Not Applicable

Serious Injury (Median, Dispersion)

0%

0.00

0%

0.00

Loss of Life (Median, Dispersion)

0%

0.00

0%

0.00

Post-event Tagging Flag:

NO

YES

Unsafe Placard Trigger (Median, Dispersion)

0%

0.00

10%

0.50

Comments:

This fragility has been changed to match B1041.121. ASCE6 is closest to column high axial OMF.

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Laura Lowes

Revisions:

2011-08-24 Negative probability below 0.1% drift - overlap deemed acceptable.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1041.071b

ACI 318 OMF weak columns w/ high axial load, Conc Col & Bm = 24" x 24", Beam both sides
ACI318 OMF, column flexure, flexural-shear, or shear failure at high axial load. Column flexural-shear response. Meets the following requirements: (1) Column Pu > 0.6Agfc, (2) Column Vn < Veq Costing is on a per joint basis.

Line 145

Construction Quality:	Not Specified			
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1		Quantity Rounding Round Qty? YES	
Demand Parameter (unit):	Story Drift Ratio		Allow sum by floor or building? NO	
Number of Damage States:	2		Demand Location (floor above?) No	
Damage State:	DS1	DS2		
Type of Damage State:	Sequential			
DS Hierarchy	Seq(DS1,DS2)			
Descriptions	Concrete Cracking: beams, joints or possibly. Residual concrete crack widths exceed 0.06in. (1.5 mm). Column exhibits residual crack widths that require epoxy injection.		Concrete Crushing: slabs, beams or joints. Spalling of beam, column or joint cover concrete exposes longitudinal reinforcement or strength loss initiates in laboratory testing. Exhibits concrete spalling that exposes longitudinal steel or crushing of core concrete.	

Illustrations



Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.0025	0.005			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	0.4	0.5			
Total Dispersion, β :	0.4	0.5			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.				

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.85E+04	3.25E+04	4.44E+04									
Best fit mean:	2.09E+04			3.18E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00									
Average Repair Cost (Min Qty, Max Qty)	2.57E+04		1.71E+04	3.90E+04		2.60E+04									
CV or beta (Min Qty, Max Qty)	0.39		0.39	0.32		0.32									
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.63E+01	2.87E+01	3.92E+01									
Best fit mean:	1.89E+01			2.87E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00									
Average Repair Time (Min Qty, Max Qty)	2.27E+01		1.51E+01	3.44E+01		2.29E+01									
CV or beta (Min Qty, Max Qty)	0.46		0.46	0.40		0.40									
Quantity Unit:	Each			Each											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		10%	0.50										

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1041.072a

ACI 318 OMF weak columns w/ high axial load, Conc Col & Bm = 24" x 36", Beam one side
ACI318 OMF, column flexure, flexural-shear, or shear failure at high axial load. Column flexural-shear response. Meets the following requirements: (1) Column Pu > 0.6Agfc, (2) Column Vn < Veq Costing is on a per joint basis.

Line 146

Construction Quality:	Not Specified			
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1		Quantity Rounding Round Qty? YES	
Demand Parameter (unit):	Story Drift Ratio		Allow sum by floor or building? NO	
Number of Damage States:	2		Demand Location (floor above?) No	
Damage State:	DS1	DS2		
Type of Damage State:	Sequential			
DS Hierarchy	Seq(DS1,DS2)			
Descriptions	Concrete Cracking: beams, joints or possibly. Residual concrete crack widths exceed 0.06in. (1.5 mm). Column exhibits residual crack widths that require epoxy injection.		Concrete Crushing: slabs, beams or joints. Spalling of beam, column or joint cover concrete exposes longitudinal reinforcement or strength loss initiates in laboratory testing. Exhibits concrete spalling that exposes longitudinal steel or crushing of core concrete.	

Illustrations

				
B1041.071a-DS1-2.JPG	B1041.071a-DS2-1.JPG			
1.00	1.00			

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	0.0025	0.005		
Data dispersion, β_d :	Not Specified	Not Specified		
Uncertainty, β_u :	0.4	0.5		
Total Dispersion, β :	0.4	0.5		
Correlation (Yes / No)	NO			
Directionality (Yes / No)	YES			
Quality Ratings				
Data Quality	Marginal			
Data Relevance	Average			
Documentation Quality	Superior			
Rationality	Superior			
Consequence Functions				
Repair Description	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.		Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04									
Best fit mean:	2.09E+04			3.31E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00									
Average Repair Cost (Min Qty, Max Qty)	2.57E+04		1.71E+04	4.14E+04		2.76E+04									
CV or beta (Min Qty, Max Qty)	0.39		0.39	0.31		0.31									
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01									
Best fit mean:	1.89E+01			3.04E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00									
Average Repair Time (Min Qty, Max Qty)	2.27E+01		1.51E+01	3.65E+01		2.43E+01									
CV or beta (Min Qty, Max Qty)	0.46		0.46	0.39		0.39									
Quantity Unit:	Each			Each											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00									
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00									
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	10%		0.50									

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description


B1041.072b

ACI 318 OMF weak columns w/ high axial load, Conc Col & Bm = 24" x 36", Beam both sides
ACI318 OMF, column flexure, flexural-shear, or shear failure at high axial load. Column flexural-shear response. Meets the following requirements: (1) Column Pu > 0.6Agfc, (2) Column Vn < Veq Costing is on a per joint basis.

Line 147

Construction Quality:	Not Specified			
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1		Quantity Rounding Round Qty? YES	
Demand Parameter (unit):	Story Drift Ratio		Allow sum by floor or building? NO	
Number of Damage States:	2		Demand Location (floor above?) No	
Damage State:	DS1	DS2		
Type of Damage State:	Sequential			
DS Hierarchy	Seq(DS1,DS2)			
Descriptions	Concrete Cracking: beams, joints or possibly. Residual concrete crack widths exceed 0.06in. (1.5 mm). Column exhibits residual crack widths that require epoxy injection.		Concrete Crushing: slabs, beams or joints. Spalling of beam, column or joint cover concrete exposes longitudinal reinforcement or strength loss initiates in laboratory testing. Exhibits concrete spalling that exposes longitudinal steel or crushing of core concrete.	

Illustrations

				
B1041.071a-DS1-2.JPG	B1041.071a-DS2-1.JPG			
1.00	1.00			

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	0.0025	0.005		
Data dispersion, β_d :	Not Specified	Not Specified		
Uncertainty, β_u :	0.4	0.5		
Total Dispersion, β :	0.4	0.5		
Correlation (Yes / No)	NO			
Directionality (Yes / No)	YES			
Quality Ratings				
Data Quality	Marginal			
Data Relevance	Average			
Documentation Quality	Superior			
Rationality	Superior			
Consequence Functions				
Repair Description	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.		Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04									
Best fit mean:	2.09E+04			3.31E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00									
Average Repair Cost (Min Qty, Max Qty)	2.57E+04		1.71E+04	4.14E+04		2.76E+04									
CV or beta (Min Qty, Max Qty)	0.39		0.39	0.31		0.31									
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01									
Best fit mean:	1.89E+01			3.04E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00									
Average Repair Time (Min Qty, Max Qty)	2.27E+01		1.51E+01	3.65E+01		2.43E+01									
CV or beta (Min Qty, Max Qty)	0.46		0.46	0.39		0.39									
Quantity Unit:	Each			Each											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00									
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00									
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	10%		0.50									

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description


B1041.073a

ACI 318 OMF weak columns w/ high axial load, Conc Col & Bm = 36" x 36", Beam one side
ACI318 OMF, column flexure, flexural-shear, or shear failure at high axial load. Column flexural-shear response. Meets the following requirements: (1) Column $P_u > 0.6A_gf'_c$, (2) Column $V_u < V_{eq}$ Costing is on a per joint basis.

Line 148

Construction Quality:	Not Specified			
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1		Quantity Rounding Round Qty? YES	
Demand Parameter (unit):	Story Drift Ratio		Allow sum by floor or building? NO	
Number of Damage States:	2		Demand Location (floor above?) No	
Damage State:	DS1	DS2		
Type of Damage State:	Sequential			
DS Hierarchy	Seq(DS1,DS2)			
Descriptions	Concrete Cracking: beams, joints or possibly. Residual concrete crack widths exceed 0.06in. (1.5 mm). Column exhibits residual crack widths that require epoxy injection.		Concrete Crushing: slabs, beams or joints. Spalling of beam, column or joint cover concrete exposes longitudinal reinforcement or strength loss initiates in laboratory testing. Exhibits concrete spalling that exposes longitudinal steel or crushing of core concrete.	

Illustrations

				
B1041.071a-DS1-2.JPG	B1041.071a-DS2-1.JPG			
1.00	1.00			

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	0.0025	0.005		
Data dispersion, β_d :	Not Specified	Not Specified		
Uncertainty, β_u :	0.4	0.5		
Total Dispersion, β :	0.4	0.5		
Correlation (Yes / No)	NO			
Directionality (Yes / No)	YES			
Quality Ratings				
Data Quality	Marginal			
Data Relevance	Average			
Documentation Quality	Superior			
Rationality	Superior			
Consequence Functions				
Repair Description	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.		Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04									
Best fit mean:	2.09E+04			3.31E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00									
Average Repair Cost (Min Qty, Max Qty)	2.57E+04		1.71E+04	4.14E+04		2.76E+04									
CV or beta (Min Qty, Max Qty)	0.39		0.39	0.31		0.31									
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01									
Best fit mean:	1.89E+01			3.04E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00									
Average Repair Time (Min Qty, Max Qty)	2.27E+01		1.51E+01	3.65E+01		2.43E+01									
CV or beta (Min Qty, Max Qty)	0.46		0.46	0.39		0.39									
Quantity Unit:	Each			Each											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00									
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00									
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	10%		0.50									

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

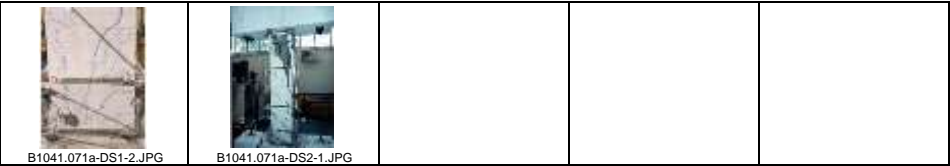
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ACI 318 OMF weak columns w/ high axial load, Conc Col & Bm = 36" x 36", Beam both sides
ACI318 OMF, column flexure, flexural-shear, or shear failure at high axial load. Column flexural-shear response. Meets the following requirements: (1) Column $P_u > 0.6A_g f'_c$, (2) Column $V_u < V_{eq}$ Costing is on a per joint basis.

Line 149

Construction Quality:	Not Specified			
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1		Quantity Rounding Round Qty? YES	
Demand Parameter (unit):	Story Drift Ratio		Allow sum by floor or building? NO	
Number of Damage States:	2		Demand Location (floor above?) No	
Damage State:	DS1	DS2		
Type of Damage State:	Sequential			
DS Hierarchy	Seq(DS1,DS2)			
Descriptions	Concrete Cracking: beams, joints or possibly. Residual concrete crack widths exceed 0.06in. (1.5 mm). Column exhibits residual crack widths that require epoxy injection.		Concrete Crushing: slabs, beams or joints. Spalling of beam, column or joint cover concrete exposes longitudinal reinforcement or strength loss initiates in laboratory testing. Exhibits concrete spalling that exposes longitudinal steel or crushing of core concrete.	

Illustrations



Damage State Probability:	1.00	1.00		
Fragility Parameters				
Median Demand, θ :	0.0025	0.005		
Data dispersion, β_d :	Not Specified	Not Specified		
Uncertainty, β_u :	0.4	0.5		
Total Dispersion, β :	0.4	0.5		
Correlation (Yes / No)	NO			
Directionality (Yes / No)	YES			
Quality Ratings				
Data Quality	Marginal			
Data Relevance	Average			
Documentation Quality	Superior			
Rationality	Superior			
Consequence Functions				
Repair Description				

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04									
Best fit mean:	2.09E+04			3.31E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00									
Average Repair Cost (Min Qty, Max Qty)	2.57E+04		1.71E+04	4.14E+04		2.76E+04									
CV or beta (Min Qty, Max Qty)	0.39		0.39	0.31		0.31									
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01									
Best fit mean:	1.89E+01			3.04E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00									
Average Repair Time (Min Qty, Max Qty)	2.27E+01		1.51E+01	3.65E+01		2.43E+01									
CV or beta (Min Qty, Max Qty)	0.46		0.46	0.39		0.39									
Quantity Unit:	Each			Each											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00									
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00									
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	10%		0.50									

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

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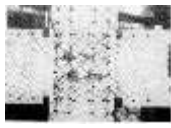

Non-conforming MF with weak joints and beam flexural response, Conc Col & Bm = 24" x 24", Beam one side
Non-Conforming MF, joint shear failure, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) ASCE41 non-compliant joint transverse reinforcing and or joint V/Vn > 1.2, (3) IGH beam ductility per ASCE41-06 Table 6-7i, (4) Compliant beam transverse reinforcing with LOW beam V / bwd(f'c)*0.5. Costing is on a per joint basis.

Line 150

Construction Quality:	Not Specified		
Seismic Installation Conditions:	Not Specified		
Fragility Unit of Measure:	EA 1		
Demand Parameter (unit):	Story Drift Ratio	Unit less	
Number of Damage States:	3		
Damage State:	DS1	DS2	DS3
Type of Damage State:	Sequential	Sequential	Sequential
DS Hierarchy	Seq(DS1,DS2,DS3)		
Descriptions	Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement or column longitudinal reinforcement in the joint. Crushing of beam or joint core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
B1041.001a-DS1-1.JPG	B1041.031a-DS2-1.JPG	B1041.031a-DS3-1.JPG		
1.00	1.00	1.00		

Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0175	0.0225	0.0322		
Data dispersion, β_d :	0.17	0.27	0.32		
Uncertainty, β_u :	0.3	0.13	0.15		
Total Dispersion, β :	0.4	0.4	0.4		

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Marginal
Data Relevance Average
Documentation Quality Superior
Rationality Superior
Consequence Functions

Repair Description
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.85E+04	3.25E+04	4.44E+04	2.30E+04	4.00E+04	5.29E+04						
Best fit mean:	2.09E+04			3.18E+04			3.86E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00						
Average Repair Cost (Min Qty, Max Qty)	2.57E+04		1.71E+04	3.90E+04		2.60E+04	4.80E+04		3.20E+04						
CV or beta (Min Qty, Max Qty)	0.39		0.39	0.32		0.32	0.30		0.30						
Quantity Unit:	Each			Each			Each								
Repair Time:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.63E+01	2.87E+01	3.92E+01	2.03E+01	3.53E+01	4.67E+01						
Best fit mean:	1.89E+01			2.87E+01			3.53E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00						
Average Repair Time (Min Qty, Max Qty)	2.27E+01		1.51E+01	3.44E+01		2.29E+01	4.23E+01		2.82E+01						
CV or beta (Min Qty, Max Qty)	0.46		0.46	0.40		0.40	0.39		0.39						
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		20%	0.50							

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: 2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

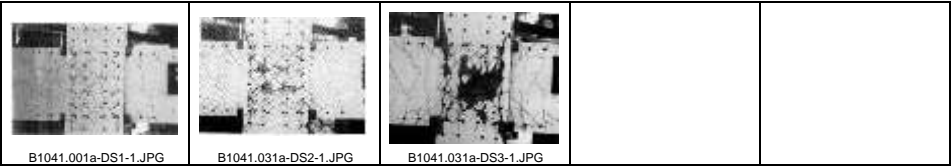
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Non-conforming MF with weak joints and beam flexural response, Conc Col & Bm = 24" x 24", Beam both sides
Non-Conforming MF, joint shear failure, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) ASCE41 non-compliant joint transverse reinforcing and or joint V/Vn > 1.2, (3) IGH beam ductility per ASCE41-06 Table 6-7i, (4) Compliant beam transverse reinforcing with LOW beam V / bwd(f'c)*0.5. Costing is on a per joint basis.

Line 151

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift RatioUnit less				
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement or column longitudinal reinforcement in the joint. Crushing of beam or joint core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.		

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0175	0.0225	0.0322		
Data dispersion, β_d :	0.17	0.27	0.32		
Uncertainty, β_u :	0.3	0.13	0.15		
Total Dispersion, β :	0.4	0.4	0.4		

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Marginal
Data Relevance Average
Documentation Quality Superior
Rationality Superior
Consequence Functions

Repair Description
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.85E+04	3.25E+04	4.44E+04	2.30E+04	4.00E+04	5.29E+04						
Best fit mean:	2.09E+04			3.18E+04			3.86E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00						
Average Repair Cost (Min Qty, Max Qty)	2.57E+04		1.71E+04	3.90E+04		2.60E+04	4.80E+04		3.20E+04						
CV or beta (Min Qty, Max Qty)	0.39		0.39	0.32		0.32	0.30		0.30						
Quantity Unit:	Each			Each			Each								
Repair Time:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.63E+01	2.87E+01	3.92E+01	2.03E+01	3.53E+01	4.67E+01						
Best fit mean:	1.89E+01			2.87E+01			3.53E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00						
Average Repair Time (Min Qty, Max Qty)	2.27E+01		1.51E+01	3.44E+01		2.29E+01	4.23E+01		2.82E+01						
CV or beta (Min Qty, Max Qty)	0.46		0.46	0.40		0.40	0.39		0.39						
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		20%	0.50							

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: 2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1041.082a

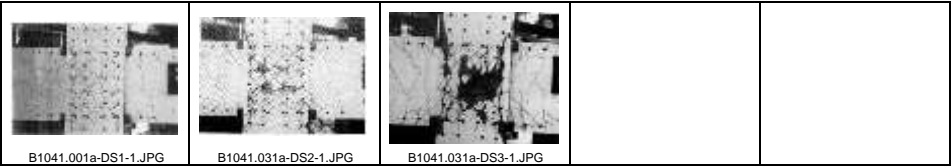
Non-conforming MF with weak joints and beam flexural response, Conc Col & Bm = 24" x 36", Beam one side
Non-Conforming MF, joint shear failure, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) ASCE41 non-compliant joint transverse reinforcing and or joint V/Vn > 1.2, (3) IGH beam ductility per ASCE41-06 Table 6-7i, (4) Compliant beam transverse reinforcing with LOW beam V / bwd(f'c)*0.5. Costing is on a per joint basis.

Line 152

Construction Quality:	Not Specified				Quantity Rounding Round Qty? YES Allow sum by floor or building? NO Demand Location (floor above)? No
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement or column longitudinal reinforcement in the joint. Crushing of beam or joint core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0175	0.0225	0.0322		
Data dispersion, β_d :	0.17	0.27	0.32		
Uncertainty, β_u :	0.3	0.13	0.15		
Total Dispersion, β :	0.4	0.4	0.4		

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Marginal
Data Relevance Average
Documentation Quality Superior
Rationality Superior
Consequence Functions

Repair Description
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete.
Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete.
Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 0.39 0.39			4.14E+04 0.31 0.31			4.92E+04 0.29 0.29								
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	2.27E+01 0.46 0.46			3.65E+01 0.39 0.39			4.34E+01 0.39 0.39								
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50								

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: 2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description


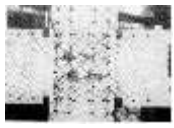

B1041.082b

Non-conforming MF with weak joints and beam flexural response, Conc Col & Bm = 24" x 36", Beam both sides
Non-Conforming MF, joint shear failure, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) ASCE41 non-compliant joint transverse reinforcing and or joint V/Vn > 1.2, (3) IGH beam ductility per ASCE41-06 Table 6-7i, (4) Compliant beam transverse reinforcing with LOW beam V / bwd(f'c)*0.5. Costing is on a per joint basis.

Line 153

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift RatioUnit less				
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement or column longitudinal reinforcement in the joint. Crushing of beam or joint core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.		

Illustrations

				
B1041.001a-DS1-1.JPG	B1041.031a-DS2-1.JPG	B1041.031a-DS3-1.JPG		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.0175	0.0225	0.0322		
Data dispersion, β_d :	0.17	0.27	0.32		
Uncertainty, β_u :	0.3	0.13	0.15		
Total Dispersion, β :	0.4	0.4	0.4		

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Marginal
Data Relevance Average
Documentation Quality Superior
Rationality Superior
Consequence Functions

Repair Description
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete.
Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete.
Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 0.39 0.39			4.14E+04 0.31 0.31			4.92E+04 0.29 0.29								
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	2.27E+01 0.46 0.46			3.65E+01 0.39 0.39			4.34E+01 0.39 0.39								
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50								

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: 2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1041.083a


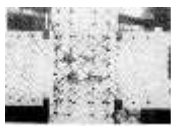
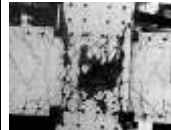
Non-conforming MF with weak joints and beam flexural response, Conc Col & Bm = 36" x 36", Beam one side
Non-Conforming MF, joint shear failure, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) ASCE41 non-compliant joint transverse reinforcing and or joint V/Vn > 1.2, (3) IGH beam ductility per ASCE41-06 Table 6-7i, (4) Compliant beam transverse reinforcing with LOW beam V / bwd(f'c)*0.5. Costing is on a per joint basis.

Line 154

Construction Quality:	Not Specified				Quantity Rounding Round Qty? YES Allow sum by floor or building? NO Demand Location (floor above)? No
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement or column longitudinal reinforcement in the joint. Crushing of beam or joint core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
B1041.001a-DS1-1.JPG	B1041.031a-DS2-1.JPG	B1041.031a-DS3-1.JPG		
1.00	1.00	1.00		

Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0175	0.0225	0.0322		
Data dispersion, β_d :	0.17	0.27	0.32		
Uncertainty, β_u :	0.3	0.13	0.15		
Total Dispersion, β :	0.4	0.4	0.4		

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Marginal
Data Relevance Average
Documentation Quality Superior
Rationality Superior
Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00						
Average Repair Cost (Min Qty, Max Qty)	2.57E+04		1.71E+04	4.14E+04		2.76E+04	4.92E+04		3.28E+04						
CV or beta (Min Qty, Max Qty)	0.39		0.39	0.31		0.31	0.29		0.29						
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00						
Average Repair Time (Min Qty, Max Qty)	2.27E+01		1.51E+01	3.65E+01		2.43E+01	4.34E+01		2.89E+01						
CV or beta (Min Qty, Max Qty)	0.46		0.46	0.39		0.39	0.39		0.39						
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		20%	0.50							

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: 2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

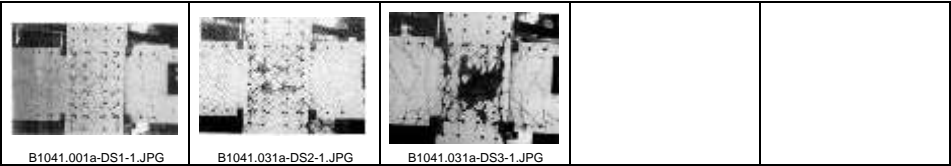
B1041.083b

Non-conforming MF with weak joints and beam flexural response, Conc Col & Bm = 36" x 36", Beam both sides
Non-Conforming MF, joint shear failure, beam flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam > 1.2, (2) ASCE41 non-compliant joint transverse reinforcing and or joint V/Vn > 1.2, (3) IGH beam ductility per ASCE41-06 Table 6-7i, (4) Compliant beam transverse reinforcing with LOW beam V / bwd(f'c)*0.5. Costing is on a per joint basis.

Line 155

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift RatioUnit less				
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Beams or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams or joints exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes a significant length of beam longitudinal reinforcement or column longitudinal reinforcement in the joint. Crushing of beam or joint core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.		

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0175	0.0225	0.0322		
Data dispersion, β_d :	0.17	0.27	0.32		
Uncertainty, β_u :	0.3	0.13	0.15		
Total Dispersion, β :	0.4	0.4	0.4		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.				

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	2.57E+04			4.14E+04			4.92E+04			3.28E+04					
CV or beta (Min Qty, Max Qty)	0.39			0.31			0.29			0.29					
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	2.27E+01			3.65E+01			4.34E+01			2.89E+01					
CV or beta (Min Qty, Max Qty)	0.46			0.39			0.39			0.39					
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			20% 0.50								

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1041.091a

Non-conforming MF with weak joints and column flexural response, Conc Col & Bm = 24" x 24", Beam one side
Non-Conforming MF, joint shear failure, column flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam < 0.8, (2) [...TBD...], (3) Non-compliant column transverse reinforcement and or joint V/Vn > 1.2 Costing is on a per joint basis.

Line 156

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Columns exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinf.	Columns exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes column transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Columns exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.015	0.0175	0.02		
Data dispersion, β_d :	Not Specified	0.27	0.18		
Uncertainty, β_u :	0.4	0.15	0.35		
Total Dispersion, β :	0.4	0.4	0.4		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description					

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.85E+04	3.25E+04	4.44E+04	2.30E+04	4.00E+04	5.29E+04						
Best fit mean:	2.09E+04			3.18E+04			3.86E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 0.39 0.39			3.90E+04 0.32 0.32			4.80E+04 0.30 0.30								
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.63E+01	2.87E+01	3.92E+01	2.03E+01	3.53E+01	4.67E+01						
Best fit mean:	1.89E+01			2.87E+01			3.53E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	2.27E+01 0.46 0.46			3.44E+01 0.40 0.40			4.23E+01 0.39 0.39								
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO						NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable						Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00						0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00						0% 0.00								
Post-event Tagging Flag:	NO						NO						YES		
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00						0% 0.00						15% 0.50		

Comments: This fragility is same as B1041.061. Closest match available.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: 2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1041.091b

Non-conforming MF with weak joints and column flexural response, Conc Col & Bm = 24" x 24", Beam both sides
Non-Conforming MF, joint shear failure, column flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam < 0.8, (2) [...TBD...], (3) Non-compliant column transverse reinforcement and/or joint V/Vn > 1.2 Costing is on a per joint basis.

Line 157

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Columns exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinf.	Columns exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes column transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Columns exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	0.015	0.0175	0.02	
Data dispersion, β_d :	Not Specified	0.27	0.18	
Uncertainty, β_u :	0.4	0.15	0.35	
Total Dispersion, β :	0.4	0.4	0.4	
Correlation (Yes / No)	NO			
Directionality (Yes / No)	YES			
Quality Ratings				
Data Quality	Marginal			
Data Relevance	Average			
Documentation Quality	Superior			
Rationality	Superior			
Consequence Functions				
Repair Description				

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.85E+04	3.25E+04	4.44E+04	2.30E+04	4.00E+04	5.29E+04						
Best fit mean:	2.09E+04			3.18E+04			3.86E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	2.57E+04 0.39 0.39			3.90E+04 0.32 0.32			4.80E+04 0.30 0.30								
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.63E+01	2.87E+01	3.92E+01	2.03E+01	3.53E+01	4.67E+01						
Best fit mean:	1.89E+01			2.87E+01			3.53E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	2.27E+01 0.46 0.46			3.44E+01 0.40 0.40			4.23E+01 0.39 0.39								
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			15% 0.50								

Comments: This fragility is same as B1041.061. Closest match available.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: 2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1041.092a

Non-conforming MF with weak joints and column flexural response, Conc Col & Bm = 24" x 36", Beam one side
Non-Conforming MF, joint shear failure, column flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam < 0.8, (2) [...TBD...], (3) Non-compliant column transverse reinforcement and or joint V/Vn > 1.2 Costing is on a per joint basis.

Line 158

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Columns exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinf.	Columns exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes column transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Columns exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	0.015	0.0175	0.02	
Data dispersion, β_d :	Not Specified	0.27	0.18	
Uncertainty, β_u :	0.4	0.15	0.35	
Total Dispersion, β :	0.4	0.4	0.4	
Correlation (Yes / No)	NO			
Directionality (Yes / No)	YES			
Quality Ratings				
Data Quality	Marginal			
Data Relevance	Average			
Documentation Quality	Superior			
Rationality	Superior			
Consequence Functions				
Repair Description	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	2.68E+04 0.39			4.31E+04 0.31			5.12E+04 0.29								
CV or beta (Min Qty, Max Qty)	0.39			0.31			0.29								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	2.36E+01 0.46			3.80E+01 0.39			4.52E+01 0.39								
CV or beta (Min Qty, Max Qty)	0.46			0.39			0.39								
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			15% 0.50								

Comments: This fragility is same as B1041.061. Closest match available.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: 2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1041.092b

Non-conforming MF with weak joints and column flexural response, Conc Col & Bm = 24" x 36", Beam both sides
Non-Conforming MF, joint shear failure, column flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam < 0.8, (2) [...TBD...], (3) Non-compliant column transverse reinforcement and/or joint V/Vn > 1.2 Costing is on a per joint basis.

Line 159

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Columns exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinf.	Columns exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes column transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Columns exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	0.015	0.0175	0.02	
Data dispersion, β_d :	Not Specified	0.27	0.18	
Uncertainty, β_u :	0.4	0.15	0.35	
Total Dispersion, β :	0.4	0.4	0.4	
Correlation (Yes / No)	NO			
Directionality (Yes / No)	YES			
Quality Ratings				
Data Quality	Marginal			
Data Relevance	Average			
Documentation Quality	Superior			
Rationality	Superior			
Consequence Functions				
Repair Description	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	2.68E+04 0.39 0.39			4.31E+04 0.31 0.31			5.12E+04 0.29 0.29								
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	2.36E+01 0.46 0.46			3.80E+01 0.39 0.39			4.52E+01 0.39 0.39								
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			15% 0.50								

Comments: This fragility is same as B1041.061. Closest match available.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: 2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1041.093a

Non-conforming MF with weak joints and column flexural response, Conc Col & Bm = 36" x 36", Beam one side
Non-Conforming MF, joint shear failure, column flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam < 0.8, (2) [...TBD...], (3) Non-compliant column transverse reinforcement and/or joint V/Vn > 1.2 Costing is on a per joint basis.

Line 160

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Columns exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinf.	Columns exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes column transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Columns exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	0.015	0.0175	0.02	
Data dispersion, β_d :	Not Specified	0.27	0.18	
Uncertainty, β_u :	0.4	0.15	0.35	
Total Dispersion, β :	0.4	0.4	0.4	
Correlation (Yes / No)	NO			
Directionality (Yes / No)	YES			
Quality Ratings				
Data Quality	Marginal			
Data Relevance	Average			
Documentation Quality	Superior			
Rationality	Superior			
Consequence Functions				
Repair Description	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00						
Average Repair Cost (Min Qty, Max Qty)	2.68E+04		1.82E+04	4.31E+04		2.93E+04	5.12E+04		3.48E+04						
CV or beta (Min Qty, Max Qty)	0.39		0.39	0.31		0.31	0.29		0.29						
Quantity Unit:	Each			Each			Each								
Repair Time:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00						
Average Repair Time (Min Qty, Max Qty)	2.36E+01		1.61E+01	3.80E+01		2.59E+01	4.52E+01		3.07E+01						
CV or beta (Min Qty, Max Qty)	0.46		0.46	0.39		0.39	0.39		0.39						
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable								
Casualty-affected Planar Area (sf) per Normative Unit:															
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		15%	0.50							

Comments: This fragility is same as B1041.061. Closest match available.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: 2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1041.093b

Non-conforming MF with weak joints and column flexural response, Conc Col & Bm = 36" x 36", Beam both sides
Non-Conforming MF, joint shear failure, column flexural response. Meets the following requirements: (1) Sum Mcol / Sum Mbeam < 0.8, (2) [...TBD...], (3) Non-compliant column transverse reinforcement and/or joint V/Vn > 1.2 Costing is on a per joint basis.

Line 161

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Columns exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinf.	Columns exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes column transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Columns exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	0.015	0.0175	0.02	
Data dispersion, β_d :	Not Specified	0.27	0.18	
Uncertainty, β_u :	0.4	0.15	0.35	
Total Dispersion, β :	0.4	0.4	0.4	
Correlation (Yes / No)	NO			
Directionality (Yes / No)	YES			
Quality Ratings				
Data Quality	Marginal			
Data Relevance	Average			
Documentation Quality	Superior			
Rationality	Superior			
Consequence Functions				
Repair Description				

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	2.68E+04 0.39			4.31E+04 0.31			5.12E+04 0.29								
CV or beta (Min Qty, Max Qty)	0.39			0.31			0.29								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	2.36E+01 0.46			3.80E+01 0.39			4.52E+01 0.39								
CV or beta (Min Qty, Max Qty)	0.46			0.39			0.39								
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			15% 0.50								

Comments: This fragility is same as B1041.061. Closest match available.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: 2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1041.101a

Non-conforming MF, weak beams and strong joints, Conc Col & Bm = 24" x 24", Beam one side
Non-Conforming MF, beam shear failure, beam flexural response. Meets the following requirements: (1) Beam with HIGH V/bwd(f'c)≥0.5 or non-compliant transverse beam reinforcing. Costing is on a per joint basis.

Line 162

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Beams exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams exhibit residual crack widths > 0.06 in. Spalling of beam cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of beam core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
B1041.051a-DS1-1.JPG	B1041.051a-DS2-1.JPG	B1041.051a-DS3-1.JPG		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.015	0.02	0.025		
Data dispersion, β_d :	Not Specified	0.27	0.15		
Uncertainty, β_u :	0.4	0.15	0.35		
Total Dispersion, β :	0.4	0.4	0.4		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description					

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.85E+04	3.25E+04	4.44E+04	2.30E+04	4.00E+04	5.29E+04						
Best fit mean:	2.09E+04			3.18E+04			3.86E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00						
Average Repair Cost (Min Qty, Max Qty)	2.68E+04		1.82E+04	4.06E+04		2.76E+04	5.00E+04		3.40E+04						
CV or beta (Min Qty, Max Qty)	0.39		0.39	0.32		0.32	0.30		0.30						
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.63E+01	2.87E+01	3.92E+01	2.03E+01	3.53E+01	4.67E+01						
Best fit mean:	1.89E+01			2.87E+01			3.53E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00						
Average Repair Time (Min Qty, Max Qty)	2.36E+01		1.61E+01	3.58E+01		2.44E+01	4.41E+01		3.00E+01						
CV or beta (Min Qty, Max Qty)	0.46		0.46	0.40		0.40	0.39		0.39						
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00						
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00						
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	0%		0.00	25%		0.50						

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1041.102a

Non-conforming MF, weak beams and strong joints, Conc Col & Bm = 24" x 36", Beam one side
Non-Conforming MF, beam shear failure, beam flexural response. Meets the following requirements: (1) Beam with HIGH V/bwd(f'c)≥0.5 or non-compliant transverse beam reinforcing. Costing is on a per joint basis.

Line 164

Construction Quality:	Not Specified		
Seismic Installation Conditions:	Not Specified		
Fragility Unit of Measure:	EA 1		
Demand Parameter (unit):	Story Drift Ratio		Unit less
Number of Damage States:	3		
Damage State:	DS1	DS2	DS3
Type of Damage State:	Sequential	Sequential	Sequential
DS Hierarchy	Seq(DS1,DS2,DS3)		
Descriptions	Beams exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams exhibit residual crack widths > 0.06 in. Spalling of beam cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of beam core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
B1041.051a-DS1-1.JPG	B1041.051a-DS2-1.JPG	B1041.051a-DS3-1.JPG		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.015	0.02	0.025		
Data dispersion, β_d :	Not Specified	0.27	0.15		
Uncertainty, β_u :	0.4	0.15	0.35		
Total Dispersion, β :	0.4	0.4	0.4		

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Marginal
Data Relevance Average
Documentation Quality Superior
Rationality Superior
Consequence Functions

Repair Description
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	2.68E+04 0.39			4.31E+04 0.31			5.12E+04 0.29								
CV or beta (Min Qty, Max Qty)	0.39			0.31			0.29								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	2.36E+01 0.46			3.80E+01 0.39			4.52E+01 0.39								
CV or beta (Min Qty, Max Qty)	0.46			0.39			0.39								
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			25% 0.50								

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: 2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1041.102b

Non-conforming MF, weak beams and strong joints, Conc Col & Bm = 24" x 36", Beam both sides
Non-Conforming MF, beam shear failure, beam flexural response. Meets the following requirements: (1) Beam with HIGH V/bwd(f'c)≥0.5 or non-compliant transverse beam reinforcing. Costing is on a per joint basis.

Line 165

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Beams exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Beams exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Beams exhibit residual crack widths > 0.06 in. Spalling of beam cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of beam core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
B1041.051a-DS1-1.JPG	B1041.051a-DS2-1.JPG	B1041.051a-DS3-1.JPG		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.015	0.02	0.025		
Data dispersion, β_d :	Not Specified	0.27	0.15		
Uncertainty, β_u :	0.4	0.15	0.35		
Total Dispersion, β :	0.4	0.4	0.4		

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Marginal
Data Relevance Average
Documentation Quality Superior
Rationality Superior
Consequence Functions

Repair Description
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	2.68E+04 0.39 0.39			4.31E+04 0.31 0.31			5.12E+04 0.29 0.29								
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	2.36E+01 0.46 0.46			3.80E+01 0.39 0.39			4.52E+01 0.39 0.39								
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			25% 0.50								

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: 2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1041.103a

Non-conforming MF, weak beams and strong joints, Conc Col & Bm = 36" x 36", Beam one side

Non-Conforming MF, beam shear failure, beam flexural response. Meets the following requirements: (1) Beam with HIGH V/bwd(f'c)≥0.5 or non-compliant transverse beam reinforcing. Costing is on a per joint basis.

Line 166

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

EA 1

Story Drift Ratio

Unit less

3

DS1

Sequential

Seq(DS1,DS2,DS3)

Beams exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.

DS2

Sequential

Beams exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

DS3

Sequential

Beams exhibit residual crack widths > 0.06 in. Spalling of beam cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of beam core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations



B1041.051a-DS1-1.JPG

1.00



B1041.051a-DS2-1.JPG

1.00



B1041.051a-DS3-1.JPG

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ:

Data dispersion, β_d:

Uncertainty, β_u:

Total Dispersion, β:

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

NO

YES

Marginal

Average

Superior

Superior

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau

(Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau

(Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

1.02E+04

2.14E+04

3.11E+04

P₁₀

P₅₀

P₉₀

1.95E+04

3.45E+04

4.54E+04

P₁₀

P₅₀

P₉₀

2.40E+04

4.10E+04

5.39E+04

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Each

P₁₀

P₅₀

P₉₀

8.98E+00

1.89E+01

2.75E+01

P₁₀

P₅₀

P₉₀

1.72E+01

3.04E+01

4.01E+01

P₁₀

P₅₀

P₉₀

2.12E+01

3.62E+01

4.76E+01

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Each

NO

NO

NO

Not Applicable

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

NO

NO

YES

0%

0.00

0%

0.00

25%

0.50

None

Not Given

By User

By User

Laura Lowes

2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1041.103b

Non-conforming MF, weak beams and strong joints, Conc Col & Bm = 36" x 36", Beam both sides

Non-Conforming MF, beam shear failure, beam flexural response. Meets the following requirements: (1) Beam with HIGH V/bwd(f'c)≥0.5 or non-compliant transverse beam reinforcing. Costing is on a per joint basis.

Line 167

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

EA 1

Story Drift Ratio

Unit less

3

DS1

Sequential

Seq(DS1,DS2,DS3)

Beams exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.

DS2

Sequential

Beams exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes beam and joint transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.

DS3

Sequential

Beams exhibit residual crack widths > 0.06 in. Spalling of beam cover concrete exposes a significant length of beam longitudinal reinforcement. Crushing of beam core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

YES

NO

No

Illustrations



B1041.051a-DS1-1.JPG

1.00



B1041.051a-DS2-1.JPG

1.00



B1041.051a-DS3-1.JPG

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ:

Data dispersion, β_d:

Uncertainty, β_u:

Total Dispersion, β:

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

NO

YES

Marginal

Average

Superior

Superior

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau

(Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau

(Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

1.02E+04

2.14E+04

3.11E+04

P₁₀

P₅₀

P₉₀

1.95E+04

3.45E+04

4.54E+04

P₁₀

P₅₀

P₉₀

2.40E+04

4.10E+04

5.39E+04

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Each

P₁₀

P₅₀

P₉₀

8.98E+00

1.89E+01

2.75E+01

P₁₀

P₅₀

P₉₀

1.72E+01

3.04E+01

4.01E+01

P₁₀

P₅₀

P₉₀

2.12E+01

3.62E+01

4.76E+01

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Each

NO

NO

NO

Not Applicable

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

NO

NO

YES

0%

0.00

0%

0.00

25%

0.50

None

Not Given

By User

By User

Laura Lowes

2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier:

1

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1041.111b

Non-conforming MF, weak columns, Conc Col & Bm = 24" x 24", Beam both sides
Non-Conforming MF, column flexure-shear or shear failure, column flexural response. Meets the following requirements: (1) [...TBD...] Costing is on a per joint basis.

Line 169

Construction Quality:	Not Specified		
Seismic Installation Conditions:	Not Specified		
Fragility Unit of Measure:	EA 1		
Demand Parameter (unit):	Story Drift Ratio	Unit less	
Number of Damage States:	3		
Damage State:	DS1	DS2	DS3
Type of Damage State:	Sequential	Sequential	Sequential
DS Hierarchy	Seq(DS1,DS2,DS3)		
Descriptions	Columns exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Columns exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes column transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Columns exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
B1041.051a-DS1-1.JPG	B1041.051a-DS2-1.JPG	B1041.051a-DS3-1.JPG		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.015	0.02	0.025		
Data dispersion, β_d :	Not Specified	0.27	0.15		
Uncertainty, β_u :	0.4	0.15	0.35		
Total Dispersion, β :	0.4	0.4	0.4		

Correlation (Yes / No) NO
Directionality (Yes / No) YES
Quality Ratings
Data Quality Marginal
Data Relevance Average
Documentation Quality Superior
Rationality Superior
Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.85E+04	3.25E+04	4.44E+04	2.30E+04	4.00E+04	5.29E+04						
Best fit mean:	2.09E+04			3.18E+04			3.86E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00						
Average Repair Cost (Min Qty, Max Qty)	2.68E+04		1.82E+04	4.06E+04		2.76E+04	5.00E+04		3.40E+04						
CV or beta (Min Qty, Max Qty)	0.39		0.39	0.32		0.32	0.30		0.30						
Quantity Unit:	Each			Each			Each								
Repair Time:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.63E+01	2.87E+01	3.92E+01	2.03E+01	3.53E+01	4.67E+01						
Best fit mean:	1.89E+01			2.87E+01			3.53E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00						
Average Repair Time (Min Qty, Max Qty)	2.36E+01		1.61E+01	3.58E+01		2.44E+01	4.41E+01		3.00E+01						
CV or beta (Min Qty, Max Qty)	0.46		0.46	0.40		0.40	0.39		0.39						
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		10%	0.50							

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: 2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1041.112a

Non-conforming MF, weak columns, Conc Col & Bm = 24" x 36", Beam one side
Non-Conforming MF, column flexure-shear or shear failure, column flexural response. Meets the following requirements: (1) [...TBD...] Costing is on a per joint basis.

Line 170

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Columns exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Columns exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes column transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Columns exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
B1041.051a-DS1-1.JPG	B1041.051a-DS2-1.JPG	B1041.051a-DS3-1.JPG		
1.00	1.00	1.00		

Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.015	0.02	0.025		
Data dispersion, β_d :	Not Specified	0.27	0.15		
Uncertainty, β_u :	0.4	0.15	0.35		
Total Dispersion, β :	0.4	0.4	0.4		

Correlation (Yes / No) NO
Directionality (Yes / No) YES
Quality Ratings
Data Quality Marginal
Data Relevance Average
Documentation Quality Superior
Rationality Superior
Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)




NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	2.68E+04 0.39			4.31E+04 0.31			5.12E+04 0.29								
CV or beta (Min Qty, Max Qty)	0.39			0.31			0.29								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	2.36E+01 0.46			3.80E+01 0.39			4.52E+01 0.39								
CV or beta (Min Qty, Max Qty)	0.46			0.39			0.39								
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			10% 0.50								

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: 2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification		B1041.112b			Line 171																								
NISTIR Name		Non-conforming MF, weak columns, Conc Col & Bm = 24" x 36", Beam both sides																											
Description		Non-Conforming MF, column flexure-shear or shear failure, column flexural response. Meets the following requirements: (1) [...] Costing is on a per joint basis.																											
Construction Quality:		Not Specified			<table><tr><td>Quantity Rounding</td><td>Round Qty?</td><td>YES</td></tr><tr><td>Allow sum by floor or building?</td><td></td><td>NO</td></tr><tr><td>Demand Location (floor above?)</td><td></td><td>No</td></tr></table>	Quantity Rounding	Round Qty?	YES	Allow sum by floor or building?		NO	Demand Location (floor above?)		No															
Quantity Rounding	Round Qty?	YES																											
Allow sum by floor or building?		NO																											
Demand Location (floor above?)		No																											
Seismic Installation Conditions:		Not Specified																											
Fragility Unit of Measure:		EA 1																											
Demand Parameter (unit):		Story Drift Ratio Unit less																											
Number of Damage States:		3																											
Damage State:		DS1	DS2	DS3																									
Type of Damage State:		Sequential	Sequential	Sequential																									
DS Hierarchy		Seq(DS1,DS2,DS3)																											
Descriptions		Columns exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Columns exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes column transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Columns exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.																									
Illustrations																													
																													
		B1041.051a-DS1-1.JPG	B1041.051a-DS2-1.JPG	B1041.051a-DS3-1.JPG																									
Damage State Probability:		1.00	1.00	1.00																									
Fragility Parameters																													
Median Demand, θ :		0.015	0.02	0.025																									
Data dispersion, β_d :		Not Specified	0.27	0.15																									
Uncertainty, β_u :		0.4	0.15	0.35																									
Total Dispersion, β :		0.4	0.4	0.4																									
Correlation (Yes / No)		NO																											
Directionality (Yes / No)		YES																											
Quality Ratings																													
Data Quality		Marginal																											
Data Relevance		Average																											
Documentation Quality		Superior																											
Rationality		Superior																											
Consequence Functions																													
Repair Description		Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).																									
Long Lead Time (Yes / No)		NO	NO	NO																									
Repair Costs:		<table><tr><td>P₁₀</td><td>P₅₀</td><td>P₉₀</td></tr><tr><td>1.02E+04</td><td>2.14E+04</td><td>3.11E+04</td></tr></table>	P ₁₀	P ₅₀	P ₉₀	1.02E+04	2.14E+04	3.11E+04	<table><tr><td>P₁₀</td><td>P₅₀</td><td>P₉₀</td></tr><tr><td>1.95E+04</td><td>3.45E+04</td><td>4.54E+04</td></tr></table>	P ₁₀	P ₅₀	P ₉₀	1.95E+04	3.45E+04	4.54E+04	<table><tr><td>P₁₀</td><td>P₅₀</td><td>P₉₀</td></tr><tr><td>2.40E+04</td><td>4.10E+04</td><td>5.39E+04</td></tr></table>	P ₁₀	P ₅₀	P ₉₀	2.40E+04	4.10E+04	5.39E+04	<table><tr><td>P₁₀</td><td>P₅₀</td><td>P₉₀</td></tr><tr><td></td><td></td><td></td></tr></table>	P ₁₀	P ₅₀	P ₉₀			
P ₁₀	P ₅₀	P ₉₀																											
1.02E+04	2.14E+04	3.11E+04																											
P ₁₀	P ₅₀	P ₉₀																											
1.95E+04	3.45E+04	4.54E+04																											
P ₁₀	P ₅₀	P ₉₀																											
2.40E+04	4.10E+04	5.39E+04																											
P ₁₀	P ₅₀	P ₉₀																											
Repair Cost by Damage State:		1.02E+04 2.14E+04 3.11E+04	1.95E+04 3.45E+04 4.54E+04	2.40E+04 4.10E+04 5.39E+04																									
Best fit mean:		2.09E+04	3.31E+04	3.96E+04																									
Best Fit Distribution:		Normal	Normal	Normal																									
Quantity Plateau (Min Qty, Max Qty)		5.00 20.00	5.00 20.00	5.00 20.00																									
Average Repair Cost (Min Qty, Max Qty)		2.68E+04 0.39 1.82E+04 0.39	4.31E+04 0.31 2.93E+04 0.31	5.12E+04 0.29 3.48E+04 0.29																									
CV or beta (Min Qty, Max Qty)																													
Quantity Unit:		Each	Each	Each																									
Repair Time:		<table><tr><td>P₁₀</td><td>P₅₀</td><td>P₉₀</td></tr><tr><td>8.98E+00</td><td>1.89E+01</td><td>2.75E+01</td></tr></table>	P ₁₀	P ₅₀	P ₉₀	8.98E+00	1.89E+01	2.75E+01	<table><tr><td>P₁₀</td><td>P₅₀</td><td>P₉₀</td></tr><tr><td>1.72E+01</td><td>3.04E+01</td><td>4.01E+01</td></tr></table>	P ₁₀	P ₅₀	P ₉₀	1.72E+01	3.04E+01	4.01E+01	<table><tr><td>P₁₀</td><td>P₅₀</td><td>P₉₀</td></tr><tr><td>2.12E+01</td><td>3.62E+01</td><td>4.76E+01</td></tr></table>	P ₁₀	P ₅₀	P ₉₀	2.12E+01	3.62E+01	4.76E+01	<table><tr><td>P₁₀</td><td>P₅₀</td><td>P₉₀</td></tr><tr><td></td><td></td><td></td></tr></table>	P ₁₀	P ₅₀	P ₉₀			
P ₁₀	P ₅₀	P ₉₀																											
8.98E+00	1.89E+01	2.75E+01																											
P ₁₀	P ₅₀	P ₉₀																											
1.72E+01	3.04E+01	4.01E+01																											
P ₁₀	P ₅₀	P ₉₀																											
2.12E+01	3.62E+01	4.76E+01																											
P ₁₀	P ₅₀	P ₉₀																											
Repair Time by Damage State:		8.98E+00 1.89E+01 2.75E+01	1.72E+01 3.04E+01 4.01E+01	2.12E+01 3.62E+01 4.76E+01																									
Best fit mean:		1.89E+01	3.04E+01	3.62E+01																									
Best Fit Distribution:		Normal	Normal	Normal																									
Quantity Plateau (Min Qty, Max Qty)		5.00 20.00	5.00 20.00	5.00 20.00																									
Average Repair Time (Min Qty, Max Qty)		2.36E+01 0.46 1.61E+01 0.46	3.80E+01 0.39 2.59E+01 0.39	4.52E+01 0.39 3.07E+01 0.39																									
CV or beta (Min Qty, Max Qty)																													
Quantity Unit:		Each	Each	Each																									
LifeSafety Hazard:																													
Potential non-collapse casualties? (Yes / No)		NO	NO	NO																									
Casualty-affected Planar Area (sf) per Normative Unit:		Not Applicable	Not Applicable	Not Applicable																									
Serious Injury (Median, Dispersion)		0% 0.00	0% 0.00	0% 0.00																									
Loss of Life (Median, Dispersion)		0% 0.00	0% 0.00	0% 0.00																									
Post-event Tagging Flag:		NO	NO	YES																									
Unsafe Placard Trigger (Median, Dispersion)		0% 0.00	0% 0.00	10% 0.50																									
Comments:		None			Root Cost Multiplier: 1																								
Date Created:		Not Given																											
Approved (YES / NO)?		By User																											
Official (YES / NO) ?		By User																											
Author:		Laura Lowes																											
Revisions:		2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.																											

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1041.113a

Non-conforming MF, weak columns, Conc Col & Bm = 36" x 36", Beam one side
Non-Conforming MF, column flexure-shear or shear failure, column flexural response. Meets the following requirements: (1) [-TBD-]. Costing is on a per joint basis.

Line 172

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Columns exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Columns exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes column transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Columns exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
B1041.051a-DS1-1.JPG	B1041.051a-DS2-1.JPG	B1041.051a-DS3-1.JPG		
1.00	1.00	1.00		

Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.015	0.02	0.025		
Data dispersion, β_d :	Not Specified	0.27	0.15		
Uncertainty, β_u :	0.4	0.15	0.35		
Total Dispersion, β :	0.4	0.4	0.4		

Correlation (Yes / No) NO
Directionality (Yes / No) YES
Quality Ratings
Data Quality Marginal
Data Relevance Average
Documentation Quality Superior
Rationality Superior
Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00						
Average Repair Cost (Min Qty, Max Qty)	2.68E+04		1.82E+04	4.31E+04		2.93E+04	5.12E+04		3.48E+04						
CV or beta (Min Qty, Max Qty)	0.39		0.39	0.31		0.31	0.29		0.29						
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00						
Average Repair Time (Min Qty, Max Qty)	2.36E+01		1.61E+01	3.80E+01		2.59E+01	4.52E+01		3.07E+01						
CV or beta (Min Qty, Max Qty)	0.46		0.46	0.39		0.39	0.39		0.39						
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		10%	0.50							

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1041.113b

Non-conforming MF, weak columns, Conc Col & Bm = 36" x 36", Beam both sides
Non-Conforming MF, column flexure-shear or shear failure, column flexural response. Meets the following requirements: (1) [...TBD...] Costing is on a per joint basis.

Line 173

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Columns exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.	Columns exhibit residual crack widths > 0.06 in. Spalling of cover concrete exposes column transverse reinforcement but not longitudinal reinforcement. No fracture or buckling of reinforcing.	Columns exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinforcing requiring replacement may occur.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
B1041.051a-DS1-1.JPG	B1041.051a-DS2-1.JPG	B1041.051a-DS3-1.JPG		
1.00	1.00	1.00		

Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.015	0.02	0.025		
Data dispersion, β_d :	Not Specified	0.27	0.15		
Uncertainty, β_u :	0.4	0.15	0.35		
Total Dispersion, β :	0.4	0.4	0.4		

Correlation (Yes / No) NO
Directionality (Yes / No) YES
Quality Ratings
Data Quality Marginal
Data Relevance Average
Documentation Quality Superior
Rationality Superior
Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged area. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged concrete at least 1 inch beyond the exposed reinforcing steel. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	1.95E+04	3.45E+04	4.54E+04	2.40E+04	4.10E+04	5.39E+04						
Best fit mean:	2.09E+04			3.31E+04			3.96E+04								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	2.68E+04 0.39			4.31E+04 0.31			5.12E+04 0.29								
CV or beta (Min Qty, Max Qty)	0.39			0.31			0.29								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	1.72E+01	3.04E+01	4.01E+01	2.12E+01	3.62E+01	4.76E+01						
Best fit mean:	1.89E+01			3.04E+01			3.62E+01								
Best Fit Distribution:	Normal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	2.36E+01 0.46			3.80E+01 0.39			4.52E+01 0.39								
CV or beta (Min Qty, Max Qty)	0.46			0.39			0.39								
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			10% 0.50								

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Laura Lowes
Revisions: 2011-08-24 DS3 beta changed from 0.3 to 0.4 in order to avoid negative probability.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1041.121a

Non-conforming MF, weak columns and strong joints, Conc Col & Bm = 24" x 24", Beam both sides

Non-Conforming MF, column flexure, flexure-shear, or shear failure, column flexural response. Meets the following requirements: (1) Column Pu > 0.67cAg, (2) Column Vn < Veq Costing is on a per joint basis.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

EA 1

Story Drift Ratio

Unit less

2

DS1

DS2

Sequential

Seq(DS1,DS2)

Concrete Cracking: beams, joints or possibly. Residual concrete crack widths exceed 0.06in. (1.5 mm). Column exhibits residual crack widths that require epoxy injection.

Concrete Crushing: slabs, beams or joints. Spalling of beam, column or joint cover concrete exposes longitudinal reinforcement or strength loss initiates in laboratory testing. Exhibits concrete spalling that exposes longitudinal steel or crushing of core concrete.

Quantity Rounding

Round Qty?

Allow sum by floor or building?


Demand Location (floor above?)


YES

NO

NO

Illustrations





B1041.071a-DS1-2.JPG

B1041.071a-DS2-1.JPG

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.00

1.00

0.0025

Not Specified

0.4

0.4

0.005

Not Specified

0.5

0.5

NO

YES

Marginal

Average

Superior

Superior

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.02E+04

2.14E+04

3.11E+04

2.45E+04

4.05E+04

5.34E+04

2.09E+04

Normal

5.00

20.00

2.68E+04

1.82E+04

0.39

0.39

Each

2.16E+01

3.57E+01

4.72E+01

3.95E+04

Normal

5.00

20.00

2.36E+01

1.61E+01

0.46

0.46

Each

2.16E+01

3.57E+01

4.72E+01

3.95E+04

Normal

5.00

20.00

2.36E+01

1.61E+01

0.46

0.46

Each

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

NO

YES

0%

0.00

10%

0.50

None

Not Given

By User

By User

Laura Lowes

2011-08-24 Negative probability below 0.1% drift - overlap deemed acceptable.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1041.121b

Non-conforming MF, weak columns and strong joints, Conc Col & Bm = 24" x 24", Beam one side

Non-Conforming MF, column flexure, flexure-shear, or shear failure, column flexural response. Meets the following requirements: (1) Column Pu > 0.67cAg, (2) Column Vn < Veq Costing is on a per joint basis.

Line 175

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

EA 1

Story Drift Ratio

Unit less

2

DS1

Sequential

Seq(DS1,DS2)

Concrete Cracking: beams, joints or possibly. Residual concrete crack widths exceed 0.06in. (1.5 mm). Column exhibits residual crack widths that require epoxy injection.

Concrete Crushing: slabs, beams or joints. Spalling of beam, column or joint cover concrete exposes longitudinal reinforcement or strength loss initiates in laboratory testing. Exhibits concrete spalling that exposes longitudinal steel or crushing of core concrete.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

YES

NO

NO

Illustrations



B1041.071a-DS1-2.JPG



B1041.071a-DS2-1.JPG

Damage State Probability:

Fragility Parameters

Median Demand, θ:

Data dispersion, βd:

Uncertainty, βu:

Total Dispersion, βt:

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.00

1.00

0.0025

Not Specified

0.4

0.4

NO

YES

Marginal

Average

Superior

Superior

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Time:

LifeSafety Hazard:

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P10

P50

P90

P10

P50

P90

P10

P50

P90

P10

P50

P90

P10

P50

P90

P10

P50

P90

8.98E+00

1.89E+01

2.75E+01

2.16E+01

3.57E+01

4.72E+01

1.89E+01

Normal

5.00

20.00

5.00

20.00

2.36E+01

1.61E+01

4.46E+01

3.04E+01

0.46

0.46

0.38

0.38

Each

Each

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

NO

YES

0%

0.00

10%

0.50

None

Not Given

By User

By User

Laura Lowes

2011-08-24 Negative probability below 0.1% drift - overlap deemed acceptable.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1041.122b

Non-conforming MF, weak columns and strong joints, Conc Col & Bm = 24" x 36", Beam both sides
Non-Conforming MF, column flexure, flexure-shear, or shear failure, column flexural response. Meets the following requirements: (1) Column Pu > 0.67cAg, (2) Column Vn < Veq Costing is on a per joint basis.

Line 177

Construction Quality:	Not Specified			
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	EA 1		Quantity Rounding Round Qty? YES	
Demand Parameter (unit):	Story Drift Ratio		Allow sum by floor or building? NO	
Number of Damage States:	2		Demand Location (floor above?) No	
Damage State:	DS1	DS2		
Type of Damage State:	Sequential			
DS Hierarchy	Seq(DS1,DS2)			
Descriptions	Concrete Cracking: beams, joints or possibly. Residual concrete crack widths exceed 0.06in. (1.5 mm). Column exhibits residual crack widths that require epoxy injection.		Concrete Crushing: slabs, beams or joints. Spalling of beam, column or joint cover concrete exposes longitudinal reinforcement or strength loss initiates in laboratory testing. Exhibits concrete spalling that exposes longitudinal steel or crushing of core concrete.	

Illustrations

				
B1041.071a-DS1-2.JPG	B1041.071a-DS2-1.JPG			
1.00	1.00			

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	0.0025	0.005		
Data dispersion, β_d :	Not Specified	Not Specified		
Uncertainty, β_u :	0.4	0.5		
Total Dispersion, β :	0.4	0.5		
Correlation (Yes / No)	NO			
Directionality (Yes / No)	YES			
Quality Ratings				
Data Quality	Marginal			
Data Relevance	Average			
Documentation Quality	Superior			
Rationality	Superior			
Consequence Functions				
Repair Description	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.		Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	2.55E+04	4.15E+04	5.44E+04									
Best fit mean:	2.09E+04			4.05E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00											
Average Repair Cost (Min Qty, Max Qty)	2.68E+04 0.39			5.19E+04 0.28											
CV or beta (Min Qty, Max Qty)	0.39			0.28											
Quantity Unit:	Each			Each											
Repair Time:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	2.25E+01	3.66E+01	4.80E+01									
Best fit mean:	1.89E+01			3.66E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00											
Average Repair Time (Min Qty, Max Qty)	2.36E+01 0.46			4.58E+01 0.37											
CV or beta (Min Qty, Max Qty)	0.46			0.37											
Quantity Unit:	Each			Each											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			10% 0.50											
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Laura Lowes														
Revisions:	2011-08-24 Negative probability below 0.1% drift - overlap deemed acceptable.														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1041.123b

Non-conforming MF, weak columns and strong joints, Conc Col & Bm = 36" x 36", Beam both sides

Non-Conforming MF, column flexure, flexure-shear, or shear failure, column flexural response. Meets the following requirements: (1) Column Pu > 0.67cAg, (2) Column Vn < Veq Costing is on a per joint basis.

Line 179

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

EA 1

Story Drift Ratio

Unit less

2

DS1

Sequential

Seq(DS1,DS2)

Concrete Cracking: beams, joints or possibly. Residual concrete crack widths exceed 0.06in. (1.5 mm). Column exhibits residual crack widths that require epoxy injection.

Concrete Crushing: slabs, beams or joints. Spalling of beam, column or joint cover concrete exposes longitudinal reinforcement or strength loss initiates in laboratory testing. Exhibits concrete spalling that exposes longitudinal steel or crushing of core concrete.

Quantity Rounding

Round Qty?

Allow sum by floor or building?


Demand Location (floor above?)

YES


NO

NO

Illustrations



B1041.071a-DS1-2.JPG



B1041.071a-DS2-1.JPG

Damage State Probability:

Fragility Parameters

Median Demand, θ:

Data dispersion, βd:

Uncertainty, βu:

Total Dispersion, βt:

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.00

1.00

0.0025

Not Specified

0.4

0.4

NO

YES

Marginal

Average

Superior

Superior

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Time:

LifeSafety Hazard:

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P10

P50

P90

P10

P50

P90

P10

P50

P90

P10

P50

P90

P10

P50

P90

8.98E+00

1.89E+01

2.75E+01

2.25E+01

3.66E+01

4.80E+01

1.89E+01

Normal

5.00

20.00

2.36E+01

0.46

Each

NO

Not Applicable

0%

0.00

NO

0%

0.00

None

Not Given

By User

By User

Laura Lowes

2011-08-24 Negative probability below 0.1% drift - overlap deemed acceptable.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1041.131a

Non-conforming MF with inadequate development of reinforcing, Conc Col & Bm = 24" x 24", Beam one side
Non-Conforming MF, non-ductile failure, non-ductile response. May exhibit the following: (1) Splice detailing or length inadequate per ASCE 41-06 Table 6-7iii, (2) Beam or column reinforcing spliced at the face of joint, (3) Beam longitudinal steel discontinuous through joint per ASCE41-06 Table 6-7iii. Costing is on a per joint basis.

Line 180

Construction Quality:	Not Specified		<div>Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No</div>					
Seismic Installation Conditions:	Not Specified							
Fragility Unit of Measure:	EA 1							
Demand Parameter (unit):	Story Drift RatioUnit less							
Number of Damage States:	2							
Damage State:	DS1		DS2					
Type of Damage State:	Sequential		Sequential					
DS Hierarchy	Seq(DS1,DS2)							
Descriptions	Damage is concentrated in beams, columns or joints depending on location of non-compliant detail. Beams, columns or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.		Damage is concentrated in beams, columns or joints depending on location of non-compliant detail. Beams, columns or joints exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinf. requiring replacement may occur.					

Illustrations					
	none	none			
Damage State Probability:	1.00	1.00			

Fragility Parameters					
Median Demand, θ :	0.015	0.02			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	0.4	0.4			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description					

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	2.45E+04	4.05E+04	5.34E+04									
Best fit mean:	2.09E+04			3.95E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00									
Average Repair Cost (Min Qty, Max Qty)	2.68E+04		1.82E+04	5.06E+04		3.44E+04									
CV or beta (Min Qty, Max Qty)	0.39		0.39	0.29		0.29									
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	2.16E+01	3.57E+01	4.72E+01									
Best fit mean:	1.89E+01			3.57E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00									
Average Repair Time (Min Qty, Max Qty)	2.36E+01		1.61E+01	4.46E+01		3.04E+01									
CV or beta (Min Qty, Max Qty)	0.46		0.46	0.38		0.38									
Quantity Unit:	Each			Each											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00									
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00									
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	10%		0.50									

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1041.131b

Non-conforming MF with inadequate development of reinforcing, Conc Col & Bm = 24" x 24", Beam both sides
Non-Conforming MF, non-ductile failure, non-ductile response. May exhibit the following: (1) Splice detailing or length inadequate per ASCE 41-06 Table 6-7iii, (2) Beam or column reinforcing spliced at the face of joint, (3) Beam longitudinal steel discontinuous through joint per ASCE41-06 Table 6-7iii. Costing is on a per joint basis.

Line 181

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	2				
Damage State:	DS1		DS2		
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Damage is concentrated in beams, columns or joints depending on location of non-compliant detail. Beams, columns or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.		Damage is concentrated in beams, columns or joints depending on location of non-compliant detail. Beams, columns or joints exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinf. requiring replacement may occur.		

Illustrations					
	none	none			
Damage State Probability:	1.00	1.00			

Fragility Parameters					
Median Demand, θ :	0.015	0.02			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	0.4	0.4			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description					

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)	NO	NO			
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Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	2.45E+04	4.05E+04	5.34E+04									
Best fit mean:	2.09E+04			3.95E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00											
Average Repair Cost (Min Qty, Max Qty)	2.68E+04 0.39			1.82E+04 0.39			5.06E+04 0.29			3.44E+04 0.29					
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	2.16E+01	3.57E+01	4.72E+01									
Best fit mean:	1.89E+01			3.57E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00											
Average Repair Time (Min Qty, Max Qty)	2.36E+01 0.46			1.61E+01 0.46			4.46E+01 0.38			3.04E+01 0.38					
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		10%	0.50										
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Laura Lowes														
Revisions:	None														
	Root Cost Multiplier: 1														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1041.132a

Non-conforming MF with inadequate development of reinforcing, Conc Col & Bm = 24" x 36", Beam one side
Non-Conforming MF, non-ductile failure, non-ductile response. May exhibit the following: (1) Splice detailing or length inadequate per ASCE 41-06 Table 6-7iii, (2) Beam or column reinforcing spliced at the face of joint, (3) Beam longitudinal steel discontinuous through joint per ASCE41-06 Table 6-7iii. Costing is on a per joint basis.

Line 182

Construction Quality:	Not Specified		<div>Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No</div>					
Seismic Installation Conditions:	Not Specified							
Fragility Unit of Measure:	EA 1							
Demand Parameter (unit):	Story Drift RatioUnit less							
Number of Damage States:	2							
Damage State:	DS1		DS2					
Type of Damage State:	Sequential		Sequential					
DS Hierarchy	Seq(DS1,DS2)							
Descriptions	Damage is concentrated in beams, columns or joints depending on location of non-compliant detail. Beams, columns or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.		Damage is concentrated in beams, columns or joints depending on location of non-compliant detail. Beams, columns or joints exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinf. requiring replacement may occur.					

Illustrations					
	none	none			
Damage State Probability:	1.00	1.00			

Fragility Parameters					
Median Demand, θ :	0.015	0.02			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	0.4	0.4			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description					

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)	NO	NO			
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Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	2.55E+04	4.15E+04	5.44E+04									
Best fit mean:	2.09E+04			4.05E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00									
Average Repair Cost (Min Qty, Max Qty)	2.68E+04		1.82E+04	5.19E+04		3.53E+04									
CV or beta (Min Qty, Max Qty)	0.39		0.39	0.28		0.28									
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	2.25E+01	3.66E+01	4.80E+01									
Best fit mean:	1.89E+01			3.66E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00									
Average Repair Time (Min Qty, Max Qty)	2.36E+01		1.61E+01	4.58E+01		3.11E+01									
CV or beta (Min Qty, Max Qty)	0.46		0.46	0.37		0.37									
Quantity Unit:	Each			Each											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		10%	0.50										
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Laura Lowes														
Revisions:	None														
							Root Cost Multiplier: 1								

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1041.132b

Non-conforming MF with inadequate development of reinforcing, Conc Col & Bm = 24" x 36", Beam both sides
Non-Conforming MF, non-ductile failure, non-ductile response. May exhibit the following: (1) Splice detailing or length inadequate per ASCE 41-06 Table 6-7iii, (2) Beam or column reinforcing spliced at the face of joint, (3) Beam longitudinal steel discontinuous through joint per ASCE41-06 Table 6-7iii. Costing is on a per joint basis.

Line 183

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	2				
Damage State:	DS1		DS2		
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Damage is concentrated in beams, columns or joints depending on location of non-compliant detail. Beams, columns or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.		Damage is concentrated in beams, columns or joints depending on location of non-compliant detail. Beams, columns or joints exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinf. requiring replacement may occur.		

Illustrations					
	none	none			
Damage State Probability:	1.00	1.00			

Fragility Parameters					
Median Demand, θ :	0.015	0.02			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	0.4	0.4			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description					

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)	NO	NO			
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Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	2.55E+04	4.15E+04	5.44E+04									
Best fit mean:	2.09E+04			4.05E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00									
Average Repair Cost (Min Qty, Max Qty)	2.68E+04		1.82E+04	5.19E+04		3.53E+04									
CV or beta (Min Qty, Max Qty)	0.39		0.39	0.28		0.28									
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	2.25E+01	3.66E+01	4.80E+01									
Best fit mean:	1.89E+01			3.66E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00									
Average Repair Time (Min Qty, Max Qty)	2.36E+01		1.61E+01	4.58E+01		3.11E+01									
CV or beta (Min Qty, Max Qty)	0.46		0.46	0.37		0.37									
Quantity Unit:	Each			Each											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		10%	0.50										
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Laura Lowes														
Revisions:	None														
							Root Cost Multiplier: 1								

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1041.133a

Non-conforming MF with inadequate development of reinforcing, Conc Col & Bm = 36" x 36", Beam one side
Non-Conforming MF, non-ductile failure, non-ductile response. May exhibit the following: (1) Splice detailing or length inadequate per ASCE 41-06 Table 6-7iii, (2) Beam or column reinforcing spliced at the face of joint, (3) Beam longitudinal steel discontinuous through joint per ASCE41-06 Table 6-7iii. Costing is on a per joint basis.

Line 184

Construction Quality:	Not Specified		<div>Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No</div>					
Seismic Installation Conditions:	Not Specified							
Fragility Unit of Measure:	EA 1							
Demand Parameter (unit):	Story Drift RatioUnit less							
Number of Damage States:	2							
Damage State:	DS1		DS2					
Type of Damage State:	Sequential		Sequential					
DS Hierarchy	Seq(DS1,DS2)							
Descriptions	Damage is concentrated in beams, columns or joints depending on location of non-compliant detail. Beams, columns or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.		Damage is concentrated in beams, columns or joints depending on location of non-compliant detail. Beams, columns or joints exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinf. requiring replacement may occur.					

Illustrations					
	none	none			
Damage State Probability:	1.00	1.00			

Fragility Parameters					
Median Demand, θ :	0.015	0.02			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	0.4	0.4			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description					

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	2.55E+04	4.15E+04	5.44E+04									
Best fit mean:	2.09E+04			4.05E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00									
Average Repair Cost (Min Qty, Max Qty)	2.68E+04		1.82E+04	5.19E+04		3.53E+04									
CV or beta (Min Qty, Max Qty)	0.39		0.39	0.28		0.28									
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	2.25E+01	3.66E+01	4.80E+01									
Best fit mean:	1.89E+01			3.66E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00									
Average Repair Time (Min Qty, Max Qty)	2.36E+01		1.61E+01	4.58E+01		3.11E+01									
CV or beta (Min Qty, Max Qty)	0.46		0.46	0.37		0.37									
Quantity Unit:	Each			Each											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00									
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00									
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	10%		0.50									

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1041.133b

Non-conforming MF with inadequate development of reinforcing, Conc Col & Bm = 36" x 36", Beam both sides
Non-Conforming MF, non-ductile failure, non-ductile response. May exhibit the following: (1) Splice detailing or length inadequate per ASCE 41-06 Table 6-7iii, (2) Beam or column reinforcing spliced at the face of joint, (3) Beam longitudinal steel discontinuous through joint per ASCE41-06 Table 6-7iii. Costing is on a per joint basis.

Line 185

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES Allow sum by floor or building? NO Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	2				
Damage State:	DS1		DS2		
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Damage is concentrated in beams, columns or joints depending on location of non-compliant detail. Beams, columns or joints exhibit residual crack widths > 0.06 in. No significant spalling. No fracture or buckling of reinforcing.		Damage is concentrated in beams, columns or joints depending on location of non-compliant detail. Beams, columns or joints exhibit residual crack widths > 0.06 in. Spalling of column cover concrete exposes a significant length of column longitudinal reinforcement. Crushing of column core concrete may occur. Fracture or buckling of reinf. requiring replacement may occur.		

Illustrations					
	none	none			
Damage State Probability:	1.00	1.00			

Fragility Parameters					
Median Demand, θ :	0.015	0.02			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	0.4	0.4			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description					

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 8 feet either side of damaged area. Clean area adjacent to the damaged concrete. Prepare spalled concrete and adjacent cracks, as necessary, to be patched and to receive the epoxy injection. Patch concrete with grout. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems as necessary.

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 15 feet either side of damaged component. Shore damaged member(s) a minimum of one level below (more levels may be required). Remove damaged component. Place and splice (as necessary) new reinforcing steel to existing, undamaged reinforcing. Place concrete forms. Place concrete. Remove forms. Remove shores after one week. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Long Lead Time (Yes / No)	NO	NO			
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Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.02E+04	2.14E+04	3.11E+04	2.55E+04	4.15E+04	5.44E+04									
Best fit mean:	2.09E+04			4.05E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00											
Average Repair Cost (Min Qty, Max Qty)	2.68E+04 0.39 0.39			5.19E+04 0.28 0.28											
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.98E+00	1.89E+01	2.75E+01	2.25E+01	3.66E+01	4.80E+01									
Best fit mean:	1.89E+01			3.66E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00											
Average Repair Time (Min Qty, Max Qty)	2.36E+01 0.46 0.46			4.58E+01 0.37 0.37											
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		10%	0.50										
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Laura Lowes														
Revisions:	None														
	Root Cost Multiplier: 1														

Root Cost Multiplier: 1

Comments:	None		
Date Created:	Not Given	Root Cost Multiplier:	1
Approved (YES / NO)?	By User		
Official (YES / NO) ?	By User		
Author:	John Wallace		
Revisions:	None		

FEMA P-58 Fragility Specification

NISTIR ClassificationB1042.001b

NISTIR NameConcrete link beam, diagonally reinforced, aspect ratio between 2.0 and 4.0, beam < 16" wide and depth < 30"

DescriptionNone

Line 241

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not applicable				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Link Beam Chord Rotation	Radians			
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Residual cracks no greater than 1/16 inch. Cracks are mainly at the beam to wall interface, some limited flexural cracking.	Residual cracks greater than 1/8 inch and minor spalling of concrete.	Significant strength degradation (<0.8Vn), buckling or fracture of diagonal reinforcing, crushing of concrete.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.0203	0.0394	0.0602		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	0.39	0.35	1		

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Not Rated
Data Relevance Not Rated
Documentation Quality Not Rated
Rationality Not Rated

Consequence Functions
Repair Description
Epoxy inject cracks (200 to 240 inches in length). Epoxy inject cracks (600 to 720 inches) and slab (300 inches), replace spalled concrete. Chip away damaged concrete, attached mechanical couplers to the diagonal bars still embedded in the wall, replace damaged or fractured reinforcing. Replace damaged concrete.

Long Lead Time (Yes / No) NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	8.13E+03	1.06E+04	2.44E+04	1.39E+04	2.78E+04	3.93E+04	2.01E+04	4.16E+04	5.90E+04						
Best fit mean:	1.24E+04			2.70E+04			4.02E+04								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	1.27E+04 8.46E+03			3.34E+04 2.23E+04			4.99E+04 3.33E+04								
CV or beta (Min Qty, Max Qty)	0.52 0.52			0.37 0.37			0.38 0.38								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.93E+00	9.02E+00	2.08E+01	1.18E+01	2.37E+01	3.35E+01	1.71E+01	3.55E+01	5.03E+01						
Best fit mean:	9.02E+00			2.37E+01			3.55E+01								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	1.08E+01 7.22E+00			2.85E+01 1.90E+01			4.25E+01 2.84E+01								
CV or beta (Min Qty, Max Qty)	0.57 0.57			0.44 0.44			0.45 0.45								
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable								
Casualty-affected Planar Area (sf) per Normative Unit:															
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			25% 0.50								

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR ClassificationB1042.002a

NISTIR NameConcrete link beam, conventionally reinforced, aspect ratio between 1.0 and 2.0, beam < 16" wide and depth < 30"

DescriptionNone

Line 242

Construction Quality:	Not Specified			
Seismic Installation Conditions:	Not applicable			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Link Beam Chord Rotation Radians			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Residual cracks no greater than 1/16 inch. Cracks are mainly at the beam to wall interface, some limited flexural cracking.	Residual cracks greater than 1/8 inch and minor spalling of concrete.	Significant strength degradation (<0.8vn), buckling or fracture of diagonal reinforcing, crushing of concrete.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.0137	0.0264	0.0428		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	0.21	0.33	0.74		

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Not Rated
Data Relevance Not Rated
Documentation Quality Not Rated
Rationality Not Rated

Consequence Functions
Repair Description
Epoxy inject cracks (200 to 240 inches in length).
Epoxy inject cracks (600 to 720 inches) and slab (300 inches), replace spalled concrete.
Chip away damaged concrete, attached mechanical couplers to the diagonal bars still embedded in the wall, replace damaged or fractured reinforcing. Replace damaged concrete.

Long Lead Time (Yes / No) NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	9.86E+03	1.29E+04	2.62E+04	1.39E+04	2.84E+04	3.93E+04	2.23E+04	4.44E+04	5.97E+04						
Best fit mean:	1.46E+04			2.72E+04			4.21E+04								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	1.55E+04 0.44 1.03E+04 0.44			3.41E+04 0.36 2.28E+04 0.36			5.33E+04 0.35 3.55E+04 0.35								
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.41E+00	1.10E+01	2.23E+01	1.18E+01	2.43E+01	3.35E+01	1.90E+01	3.79E+01	5.09E+01						
Best fit mean:	1.10E+01			2.43E+01			3.79E+01								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	1.32E+01 0.50 8.81E+00 0.50			2.91E+01 0.44 1.94E+01 0.44			4.54E+01 0.43 3.03E+01 0.43								
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			25% 0.50								

Comments:None

Date Created:Not Given

Approved (YES / NO)?By User

Official (YES / NO) ?By User

Author:John Wallace

Revisions:None

Root Cost Multiplier:1

FEMA P-58 Fragility Specification

NISTIR ClassificationB1042.002b

NISTIR NameConcrete link beam, conventionally reinforced, aspect ratio between 2.0 and 4.0, beam < 16" wide and depth < 30"

DescriptionNone

Line 243

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not applicable				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Link Beam Chord Rotation	Radians			
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Residual cracks no greater than 1/16 inch. Cracks are mainly at the beam to wall interface, some limited flexural cracking.	Residual cracks greater than 1/8 inch and minor spalling of concrete.	Significant strength degradation (<0.8Vn), buckling or fracture of diagonal reinforcing, crushing of concrete.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.0137	0.0264	0.0407		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	0.21	0.33	0.75		

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Not Rated
Data Relevance Not Rated
Documentation Quality Not Rated
Rationality Not Rated

Consequence Functions
Repair Description
Epoxy inject cracks (200 to 240 inches in length). Epoxy inject cracks (600 to 720 inches) and slab (300 inches), replace spalled concrete. Chip away damaged concrete, attached mechanical couplers to the diagonal bars still embedded in the wall, replace damaged or fractured reinforcing. Replace damaged concrete.

Long Lead Time (Yes / No) NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	8.13E+03	1.06E+04	2.44E+04	1.39E+04	2.78E+04	3.93E+04	2.01E+04	4.16E+04	5.90E+04						
Best fit mean:	1.24E+04			2.70E+04			4.02E+04								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	1.27E+04 8.46E+03			3.34E+04 2.23E+04			4.99E+04 3.33E+04								
CV or beta (Min Qty, Max Qty)	0.52 0.52			0.37 0.37			0.38 0.38								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.93E+00	9.02E+00	2.08E+01	1.18E+01	2.37E+01	3.35E+01	1.71E+01	3.55E+01	5.03E+01						
Best fit mean:	9.02E+00			2.37E+01			3.55E+01								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	1.08E+01 7.22E+00			2.85E+01 1.90E+01			4.25E+01 2.84E+01								
CV or beta (Min Qty, Max Qty)	0.57 0.57			0.44 0.44			0.45 0.45								
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable								
Casualty-affected Planar Area (sf) per Normative Unit:															
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			25% 0.50								

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR ClassificationB1042.011a

NISTIR NameConcrete link beam, diagonally reinforced, aspect ratio between 1.0 and 2.0, beam > 16" wide and depth < 30"

DescriptionNone

Line 244

Construction Quality:	Not Specified			
Seismic Installation Conditions:	Not applicable			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Link Beam Chord Rotation Radians			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Residual cracks no greater than 1/16 inch. Cracks are mainly at the beam to wall interface, some limited flexural cracking.	Residual cracks greater than 1/8 inch and minor spalling of concrete.	Significant strength degradation (<0.8vn), buckling or fracture of diagonal reinforcing, crushing of concrete.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	none	none		
	1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.0179	0.0352	0.0543		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	0.38	0.44	0.95		

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Not Rated
Data Relevance Not Rated
Documentation Quality Not Rated
Rationality Not Rated

Consequence Functions
Repair Description
Epoxy inject cracks (200 to 240 inches in length). Epoxy inject cracks (600 to 720 inches) and slab (300 inches), replace spalled concrete. Chip away damaged concrete, attached mechanical couplers to the diagonal bars still embedded in the wall, replace damaged or fractured reinforcing. Replace damaged concrete.

Long Lead Time (Yes / No) NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	9.86E+03	1.29E+04	2.62E+04	1.49E+04	2.94E+04	4.03E+04	2.33E+04	4.54E+04	6.07E+04						
Best fit mean:	1.46E+04			2.82E+04			4.31E+04								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	1.55E+04 0.44 1.03E+04 0.44			3.53E+04 0.35 2.36E+04 0.35			5.45E+04 0.34 3.63E+04 0.34								
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.41E+00	1.10E+01	2.23E+01	1.27E+01	2.51E+01	3.43E+01	1.99E+01	3.87E+01	5.18E+01						
Best fit mean:	1.10E+01			2.51E+01			3.87E+01								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	1.32E+01 0.50 8.81E+00 0.50			3.01E+01 0.43 2.01E+01 0.43			4.65E+01 0.42 3.10E+01 0.42								
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			25% 0.50								

Comments:None

Date Created:Not Given

Approved (YES / NO)?By User

Official (YES / NO) ?By User

Author:John Wallace

Revisions:None

Root Cost Multiplier:1

FEMA P-58 Fragility Specification

NISTIR Classification B1042.011b
NISTIR Name Concrete link beam, diagonally reinforced, aspect ratio between 2.0 and 4.0, beam > 16" wide and depth < 30"
Description None

Line 245

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not applicable				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Link Beam Chord Rotation	Radians			
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Residual cracks no greater than 1/16 inch. Cracks are mainly at the beam to wall interface, some limited flexural cracking.	Residual cracks greater than 1/8 inch and minor spalling of concrete.	Significant strength degradation (<0.8Vn), buckling or fracture of diagonal reinforcing, crushing of concrete.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.0203	0.0394	0.0602		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	0.39	0.35	1		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Epoxy inject cracks (200 to 240 inches in length).	Epoxy inject cracks (600 to 720 inches) and slab (300 inches), replace spalled concrete.	Chip away damaged concrete, attached mechanical couplers to the diagonal bars still embedded in the wall, replace damaged or fractured reinforcing. Replace damaged concrete.		

Long Lead Time (Yes / No) NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	8.13E+03	1.06E+04	2.44E+04	1.49E+04	2.88E+04	4.03E+04	2.11E+04	4.26E+04	6.00E+04						
Best fit mean:	1.24E+04			2.80E+04			4.12E+04								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00						
Average Repair Cost (Min Qty, Max Qty)	1.27E+04		8.46E+03	3.46E+04		2.31E+04	5.11E+04		3.41E+04						
CV or beta (Min Qty, Max Qty)	0.52		0.52	0.35		0.35	0.37		0.37						
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.93E+00	9.02E+00	2.08E+01	1.27E+01	2.46E+01	3.43E+01	1.80E+01	3.63E+01	5.12E+01						
Best fit mean:	9.02E+00			2.46E+01			3.63E+01								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00	5.00		20.00	5.00		20.00						
Average Repair Time (Min Qty, Max Qty)	1.08E+01		7.22E+00	2.95E+01		1.97E+01	4.36E+01		2.90E+01						
CV or beta (Min Qty, Max Qty)	0.57		0.57	0.43		0.43	0.45		0.45						
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		25%	0.50							
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO)?	By User														
Author:	John Wallace														
Revisions:	None														
Root Cost Multiplier: 1															

Root Cost Multiplier: 1

Root Cost Multiplier: 1

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1042.021a
NISTIR Name Concrete link beam, diagonally reinforced, aspect ratio between 1.0 and 2.0, beam > 24" wide and depth < 30"
Description None

Line 248

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>
Seismic Installation Conditions:	Not applicable				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Link Beam Chord Rotation	Radians			
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Residual cracks no greater than 1/16 inch. Cracks are mainly at the beam to wall interface, some limited flexural cracking.	Residual cracks greater than 1/8 inch and minor spalling of concrete.	Significant strength degradation (<0.8Vn), buckling or fracture of diagonal reinforcing, crushing of concrete.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	none	none		
	1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.0179	0.0352	0.0543		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	0.38	0.44	0.95		

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Not Rated
Data Relevance Not Rated
Documentation Quality Not Rated
Rationality Not Rated

Consequence Functions
Repair Description
Epoxy inject cracks (200 to 240 inches in length). Epoxy inject cracks (600 to 720 inches) and slab (300 inches), replace spalled concrete. Chip away damaged concrete, attached mechanical couplers to the diagonal bars still embedded in the wall, replace damaged or fractured reinforcing. Replace damaged concrete.

Long Lead Time (Yes / No) NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	9.86E+03	1.29E+04	2.62E+04	1.49E+04	2.94E+04	4.03E+04	2.33E+04	4.64E+04	6.07E+04						
Best fit mean:	1.46E+04			2.82E+04			4.35E+04								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	1.55E+04 0.44 1.03E+04 0.44			3.53E+04 0.35 2.36E+04 0.35			5.57E+04 0.34 3.71E+04 0.34								
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.41E+00	1.10E+01	2.23E+01	1.27E+01	2.51E+01	3.43E+01	1.99E+01	3.96E+01	5.18E+01						
Best fit mean:	1.10E+01			2.51E+01			3.96E+01								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	1.32E+01 0.50 8.81E+00 0.50			3.01E+01 0.43 2.01E+01 0.43			4.75E+01 0.42 3.17E+01 0.42								
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable								
Casualty-affected Planar Area (sf) per Normative Unit:															
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			25% 0.50								

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: John Wallace
Revisions: None
Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR ClassificationB1042.021b

NISTIR NameConcrete link beam, diagonally reinforced, aspect ratio between 2.0 and 4.0, beam > 24" wide and depth < 30"

DescriptionNone

Line 249

Construction Quality:	Not Specified			
Seismic Installation Conditions:	Not applicable			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Link Beam Chord Rotation Radians			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Residual cracks no greater than 1/16 inch. Cracks are mainly at the beam to wall interface, some limited flexural cracking.	Residual cracks greater than 1/8 inch and minor spalling of concrete.	Significant strength degradation (<0.8vn), buckling or fracture of diagonal reinforcing, crushing of concrete.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.0203	0.0394	0.0602		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	0.39	0.35	1		

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Not Rated
Data Relevance Not Rated
Documentation Quality Not Rated
Rationality Not Rated

Consequence Functions
Repair Description
Epoxy inject cracks (200 to 240 inches in length).
Epoxy inject cracks (600 to 720 inches) and slab (300 inches), replace spalled concrete.
Chip away damaged concrete, attached mechanical couplers to the diagonal bars still embedded in the wall, replace damaged or fractured reinforcing. Replace damaged concrete.

Long Lead Time (Yes / No) NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	8.13E+03	1.06E+04	2.44E+04	1.49E+04	2.88E+04	4.03E+04	2.11E+04	4.36E+04	6.00E+04						
Best fit mean:	1.24E+04			2.80E+04			4.15E+04								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Cost (Min Qty, Max Qty)	1.27E+04 8.46E+03			3.46E+04 2.31E+04			5.23E+04 3.49E+04								
CV or beta (Min Qty, Max Qty)	0.52 0.52			0.35 0.35			0.37 0.37								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.93E+00	9.02E+00	2.08E+01	1.27E+01	2.46E+01	3.43E+01	1.80E+01	3.72E+01	5.12E+01						
Best fit mean:	9.02E+00			2.46E+01			3.72E+01								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 20.00			5.00 20.00			5.00 20.00								
Average Repair Time (Min Qty, Max Qty)	1.08E+01 7.22E+00			2.95E+01 1.97E+01			4.46E+01 2.97E+01								
CV or beta (Min Qty, Max Qty)	0.57 0.57			0.43 0.43			0.44 0.44								
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			25% 0.50								

Root Cost Multiplier: 1

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1044.002

Rectangular low aspect ratio concrete walls 8" or less thick single curtain 16' high to 24' high
Costing for each 400 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Line 187

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above)?No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	SF 400				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Cracks with maximum widths greater than 0.04 in but less than 0.12 in.	Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.	Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	NO	

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0055	0.0109	0.013		
Data dispersion, β_d :	0.35	0.27	0.35		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.36	0.3	0.36		

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Average
Data Relevance Average
Documentation Quality Superior
Rationality Superior

Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

(1) Relocate office eqpt & furniture within 6 ft. of wall, both sides. Install protective covers on floor finishes & adjacent curtain wall system. (2) Remove arch. finishes on wall, both sides. (3) Relocate MEP systems within 6 ft. of wall. (4) Prepare & inject grout 330 ft. of crack per 100 ft2 of wall. (5) Remove 15 ft2 per 100 ft2 of wall & 10 1-ft. long sections of #8 buckled vert. rebar. (6) Replace buckled rebar with new rebar, attach to exposed ends of (E) rebar with mech splices; provide 8 #4 seismic ties at 4 in. oc, ea end of wall; re-bend 16 horiz. rebar in wall around new rebar. (7) Install formwork & cast 5ksi concrete into pockets cut in step 5. (8) Strip forms, clean-up, reinstall/return

(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12#9 A706 bars in bz ea. end; mech splices to (E); b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/fdn at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt,

Long Lead Time (Yes / No) NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.44E+04	1.64E+04	1.96E+04	3.32E+04	3.72E+04	4.48E+04	5.32E+04	6.03E+04	7.67E+04						
Best fit mean:	1.67E+04			3.81E+04			6.26E+04								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00			3.00 7.00								
Average Repair Cost (Min Qty, Max Qty)	2.05E+04 0.12			4.65E+04 0.12			7.54E+04 0.15								
CV or beta (Min Qty, Max Qty)	0.12			0.12			0.15								
Quantity Unit:	400 ft^2 Units			400 ft^2 Units			400 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.34E+01	1.52E+01	1.82E+01	3.07E+01	3.44E+01	4.15E+01	4.93E+01	5.59E+01	7.10E+01						
Best fit mean:	1.52E+01			3.44E+01			5.59E+01								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00			3.00 7.00								
Average Repair Time (Min Qty, Max Qty)	1.90E+01 0.28			4.30E+01 0.28			6.99E+01 0.29								
CV or beta (Min Qty, Max Qty)	0.28			0.28			0.29								
Quantity Unit:	400 ft^2 Units			400 ft^2 Units			400 ft^2 Units								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			50% 0.50			25% 0.50								

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Andrew Whittaker
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 400

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1044.003
Rectangular low aspect ratio concrete walls 8" or less thick single curtain 25' high to 40' high
Costing for each 900 ft*2 Wall Panel, Orthogonal web reinforcement, $f_c > 2500$ psi, $P/(A*F_c) \leq 0.2$

Line 188

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above)?No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	SF 900				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Cracks with maximum widths greater than 0.04 in but less than 0.12 in.	Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.	Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0055	0.0109	0.013		
Data dispersion, β_d :	0.35	0.27	0.35		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.36	0.3	0.36		

Correlation (Yes / No) NO
Directionality (Yes / No) YES
Quality Ratings
Data Quality Average
Data Relevance Average
Documentation Quality Superior
Rationality Superior
Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

(1) Relocate office eqpt & furniture within 6 ft. of wall, both sides. Install protective covers on floor finishes & adjacent curtain wall system. (2) Remove arch. finishes on wall, both sides. (3) Relocate MEP systems within 6 ft. of wall. (4) Prepare & inject grout 330 ft. of crack per 100 ft2 of wall. (5) Remove 15 ft2 per 100 ft2 of wall & 10 1-ft. long sections of #8 buckled vert. rebar. (6) Replace buckled rebar with new rebar, attach to exposed ends of (E) rebar with mech splices; provide 8 #4 seismic ties at 4 in. oc, ea end of wall; re-bend 16 horiz. rebar in wall around new rebar. (7) Install formwork & cast 5ksi concrete into pockets cut in step 5. (8) Strip forms, clean-up, reinstall/return

(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12#9 A706 bars in bz ea. end; mech splices to (E); b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt,

Long Lead Time (Yes / No) NO NO NO

Repair Costs:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Cost by Damage State:	3.14E+04	3.42E+04	4.19E+04	7.36E+04	7.90E+04	9.16E+04	1.00E+05	1.19E+05	1.48E+05						
Best fit mean:	3.56E+04			8.11E+04			1.21E+05								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00			3.00 7.00								
Average Repair Cost (Min Qty, Max Qty)	4.28E+04 0.12 2.91E+04 0.12			9.88E+04 0.09 6.72E+04 0.09			1.48E+05 0.15 1.01E+05 0.15								
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	900 ft*2 Units			900 ft*2 Units			900 ft*2 Units								
Repair Time:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Time by Damage State:	3.00E+01	3.27E+01	4.01E+01	7.04E+01	7.56E+01	8.76E+01	9.58E+01	1.13E+02	1.41E+02						
Best fit mean:	3.27E+01			7.56E+01			1.13E+02								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00			3.00 7.00								
Average Repair Time (Min Qty, Max Qty)	4.08E+01 0.28 2.78E+01 0.28			9.45E+01 0.26 6.43E+01 0.26			1.42E+02 0.29 9.65E+01 0.29								
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	900 ft*2 Units			900 ft*2 Units			900 ft*2 Units								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			50% 0.50			25% 0.50								

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Andrew Whittaker
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 900

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1044.011
Rectangular low aspect ratio concrete walls 8"-16" double curtain; with heights of up to 15'
Costing for each 144 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Line 189

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	SF 144				
Demand Parameter (unit):	Story Drift Ratio	Unit less			
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Cracks with maximum widths greater than 0.04 in but less than 0.12 in.	Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.	Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	NO	

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, δ :	0.0055	0.0109	0.013		
Data dispersion, β_d :	0.35	0.27	0.35		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.36	0.3	0.36		

Correlation (Yes / No) NO
Directionality (Yes / No) YES
Quality Ratings
Data Quality Average
Data Relevance Average
Documentation Quality Superior
Rationality Superior
Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

(1) Relocate office eqpt & furniture within 6 ft. of wall, both sides. Install protective covers on floor finishes & adjacent curtain wall system. (2) Remove arch. finishes on wall, both sides. (3) Relocate MEP systems within 6 ft. of wall. (4) Prepare & inject grout 330 ft. of crack per 100 ft2 of wall. (5) Remove 15 ft2 per 100 ft2 of wall & 10 1-ft. long sections of #8 buckled vert. rebar. (6) Replace buckled rebar with new rebar, attach to exposed ends of (E) rebar with mech splices; provide 8 #4 seismic ties at 4 in. oc, ea end of wall; re-bend 16 horiz. rebar in wall around new rebar. (7) Install formwork & cast 5ksi concrete into pockets cut in step 5. (8) Strip forms, clean-up, reinstall/return

(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12#9 A706 bars in bz ea. end; mech splices to (E); b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/fdn at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt,

Long Lead Time (Yes / No) NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	5.47E+03	6.05E+03	7.97E+03	1.41E+04	1.56E+04	1.93E+04	2.67E+04	2.92E+04	3.55E+04						
Best fit mean:	6.41E+03			1.62E+04			3.02E+04								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00			3.00 7.00								
Average Repair Cost (Min Qty, Max Qty)	7.56E+03 5.14E+03			1.95E+04 1.33E+04			3.64E+04 2.48E+04								
CV or beta (Min Qty, Max Qty)	0.16 0.16			0.13 0.13			0.11 0.11								
Quantity Unit:	144 ft^2 Units			144 ft^2 Units			144 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	4.26E+00	4.71E+00	6.21E+00	1.10E+01	1.22E+01	1.50E+01	2.08E+01	2.27E+01	2.76E+01						
Best fit mean:	4.71E+00			1.22E+01			2.27E+01								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00			3.00 7.00								
Average Repair Time (Min Qty, Max Qty)	5.89E+00 4.00E+00			1.52E+01 1.03E+01			2.84E+01 1.93E+01								
CV or beta (Min Qty, Max Qty)	0.29 0.29			0.28 0.28			0.28 0.28								
Quantity Unit:	144 ft^2 Units			144 ft^2 Units			144 ft^2 Units								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			50% 0.50			25% 0.50								

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Andrew Whittaker
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 144

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1044.012

Rectangular low aspect ratio concrete walls 8"-16" double curtain; with heights of 16' to 24'
Costing for each 400 ft^2 Wall Panel, Orthogonal web reinforcement, $f_c > 2500$ psi, $P/(A \cdot f_c) \leq 0.2$

Line 190

Construction Quality: Not Specified
Seismic Installation Conditions: Not Specified

Fragility Unit of Measure:	SF 400
Demand Parameter (unit):	Story Drift Ratio Unit less

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	NO	

Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	

Seq(DS1,DS2,DS3)			
Cracks with maximum widths greater than 0.04 in but less than 0.12 in.	Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.	Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.	

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, δ :	0.0055	0.0109	0.013		
Data dispersion, β_d :	0.35	0.27	0.35		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.36	0.3	0.36		

Correlation (Yes / No) NO
Directionality (Yes / No) YES
Quality Ratings
Data Quality Average
Data Relevance Average
Documentation Quality Superior
Rationality Superior
Consequence Functions

Repair Description
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).
(1) Relocate office eqpt & furniture within 6 ft. of wall, both sides. Install protective covers on floor finishes & adjacent curtain wall system. (2) Remove arch. finishes on wall, both sides. (3) Relocate MEP systems within 6 ft. of wall. (4) Prepare & inject grout 330 ft. of crack per 100 ft2 of wall. (5) Remove 15 ft2 per 100 ft2 of wall & 10 1-ft. long sections of #8 buckled vert. rebar. (6) Replace buckled rebar with new rebar, attach to exposed ends of (E) rebar with mech splices; provide 8 #4 seismic ties at 4 in. oc, ea end of wall; re-bend 16 horiz. rebar in wall around new rebar. (7) Install formwork & cast 5ksi concrete into pockets cut in step 5. (8) Strip forms, clean-up, reinstall/return
(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12#9 A706 bars in bz ea. end; mech splices to (E); b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt,

Long Lead Time (Yes / No) NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.68E+04	1.88E+04	2.20E+04	3.87E+04	4.25E+04	5.01E+04	6.90E+04	7.57E+04	9.08E+04						
Best fit mean:	1.91E+04			4.35E+04			7.80E+04								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00	7.00		3.00	7.00		3.00	7.00							
Average Repair Cost (Min Qty, Max Qty)	2.35E+04	1.60E+04		5.31E+04	3.61E+04		9.47E+04	6.44E+04							
CV or beta (Min Qty, Max Qty)	0.11	0.11		0.10	0.10		0.11	0.11							
Quantity Unit:	400 ft^2 Units			400 ft^2 Units			400 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.56E+01	1.74E+01	2.04E+01	3.58E+01	3.94E+01	4.64E+01	6.39E+01	7.02E+01	8.42E+01						
Best fit mean:	1.74E+01			3.94E+01			7.02E+01								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00	7.00		3.00	7.00		3.00	7.00							
Average Repair Time (Min Qty, Max Qty)	2.18E+01	1.48E+01		4.92E+01	3.35E+01		8.77E+01	5.96E+01							
CV or beta (Min Qty, Max Qty)	0.27	0.27		0.27	0.27		0.27	0.27							
Quantity Unit:	400 ft^2 Units			400 ft^2 Units			400 ft^2 Units								
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		50%	0.50		25%	0.50							

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Andrew Whittaker
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 400

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1044.013

Rectangular low aspect ratio concrete walls 8"-16" double curtain; with heights of 24' to 40'
Costing for each 900 ft² Wall Panel, Orthogonal web reinforcement, $f_c > 2500$ psi, $P/(A \cdot f_c) \leq 0.2$

Line 191

Construction Quality: Not Specified
Seismic Installation Conditions: Not Specified

Fragility Unit of Measure: SF 900

Demand Parameter (unit): Story Drift Ratio Unit less

Number of Damage States: 3

Damage State: DS1 Sequential DS2 Sequential DS3 Sequential

Type of Damage State: Seq(DS1,DS2,DS3)

DS Hierarchy
Descriptions
Cracks with maximum widths greater than 0.04 in but less than 0.12 in.
Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.
Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.

Quantity Rounding Round Qty? NO
Allow sum by floor or building? NO
Demand Location (floor above?) No

Illustrations



Damage State Probability: 1.00 1.00 1.00

Fragility Parameters					
Median Demand, δ :	0.0055	0.0109	0.013		
Data dispersion, β_d :	0.35	0.27	0.35		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.36	0.3	0.36		

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Average
Data Relevance Average
Documentation Quality Superior
Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

(1) Relocate office eqpt & furniture within 6 ft. of wall, both sides. Install protective covers on floor finishes & adjacent curtain wall system. (2) Remove arch. finishes on wall, both sides. (3) Relocate MEP systems within 6 ft. of wall. (4) Prepare & inject grout 330 ft. of crack per 100 ft² of wall. (5) Remove 15 ft² per 100 ft² of wall & 10 1-ft. long sections of #8 buckled vert. rebar. (6) Replace buckled rebar with new rebar, attach to exposed ends of (E) rebar with mech splices; provide 8 #4 seismic ties at 4 in. oc, ea end of wall; re-bend 16 horiz. rebar in wall around new rebar. (7) Install formwork & cast 5ksi concrete into pockets cut in step 5. (8) Strip forms, clean-up, reinstall/return

(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12#9 A706 bars in bz ea. end; mech splices to (E); b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt,

Long Lead Time (Yes / No) NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.68E+04	3.96E+04	4.73E+04	8.57E+04	9.11E+04	1.04E+05	1.29E+05	1.47E+05	1.74E+05						
Best fit mean:	4.10E+04			9.32E+04			1.49E+05								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00			3.00 7.00								
Average Repair Cost (Min Qty, Max Qty)	4.95E+04 0.10			1.14E+05 0.08			1.84E+05 0.12			1.25E+05 0.12					
CV or beta (Min Qty, Max Qty)	0.10			0.08			0.12			0.12					
Quantity Unit:	900 ft² Units			900 ft² Units			900 ft² Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.52E+01	3.79E+01	4.53E+01	8.19E+01	8.70E+01	9.91E+01	1.24E+02	1.41E+02	1.67E+02						
Best fit mean:	3.79E+01			8.70E+01			1.41E+02								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00			3.00 7.00								
Average Repair Time (Min Qty, Max Qty)	4.74E+01 0.27			1.09E+02 0.26			1.76E+02 0.28			1.20E+02 0.28					
CV or beta (Min Qty, Max Qty)	0.27			0.26			0.28			0.28					
Quantity Unit:	900 ft² Units			900 ft² Units			900 ft² Units								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			50% 0.50			25% 0.50								

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Andrew Whittaker

Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 900

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1044.022

Rectangular low aspect ratio concrete walls 18"-24" thick with double curtain and heights 16' - 24'
Costing for each 400 ft^2 Wall Panel, Orthogonal web reinforcement, $f_c > 2500$ psi, $P/(A \cdot f_c) \leq 0.2$

Line 193

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	SF 400				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Cracks with maximum widths greater than 0.04 in but less than 0.12 in.	Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.	Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	NO	

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0055	0.0109	0.013		
Data dispersion, β_d :	0.35	0.27	0.35		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.36	0.3	0.36		

Correlation (Yes / No) NO
Directionality (Yes / No) YES
Quality Ratings
Data Quality Average
Data Relevance Average
Documentation Quality Superior
Rationality Superior
Consequence Functions
Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

(1) Relocate office eqpt & furniture within 6 ft. of wall, both sides. Install protective covers on floor finishes & adjacent curtain wall system. (2) Remove arch. finishes on wall, both sides. (3) Relocate MEP systems within 6 ft. of wall. (4) Prepare & inject grout 330 ft. of crack per 100 ft2 of wall. (5) Remove 15 ft2 per 100 ft2 of wall & 10 1-ft. long sections of #8 buckled vert. rebar. (6) Replace buckled rebar with new rebar, attach to exposed ends of (E) rebar with mech splices; provide 8 #4 seismic ties at 4 in. oc, ea end of wall; re-bend 16 horiz. rebar in wall around new rebar. (7) Install formwork & cast 5ksi concrete into pockets cut in step 5. (8) Strip forms, clean-up, reinstall/return

(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12#9 A706 bars in bz ea. end; mech splices to (E); b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/fdn at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt,

Long Lead Time (Yes / No) NO NO NO

Repair Costs:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Cost by Damage State:	2.28E+04	2.48E+04	2.80E+04	4.77E+04	5.15E+04	5.91E+04	8.66E+04	9.73E+04	1.09E+05						
Best fit mean:	2.51E+04			5.26E+04			9.73E+04								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00			3.00 7.00								
Average Repair Cost (Min Qty, Max Qty)	3.10E+04 2.11E+04			6.44E+04 4.38E+04			1.22E+05 8.27E+04								
CV or beta (Min Qty, Max Qty)	0.08 0.08			0.09 0.09			0.09 0.09								
Quantity Unit:	400 ft^2 Units			400 ft^2 Units			400 ft^2 Units								
Repair Time:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Time by Damage State:	2.11E+01	2.30E+01	2.60E+01	4.42E+01	4.77E+01	5.48E+01	8.02E+01	9.02E+01	1.01E+02						
Best fit mean:	2.30E+01			4.77E+01			9.02E+01								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00			3.00 7.00								
Average Repair Time (Min Qty, Max Qty)	2.87E+01 1.95E+01			5.96E+01 4.06E+01			1.13E+02 7.66E+01								
CV or beta (Min Qty, Max Qty)	0.26 0.26			0.26 0.26			0.27 0.27								
Quantity Unit:	400 ft^2 Units			400 ft^2 Units			400 ft^2 Units								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			50% 0.50			25% 0.50								

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Andrew Whittaker
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 400

FEMA P-58 Fragility Specification

NISTIR Classification B1044.031

NISTIR Name Low-rise reinforced concrete walls with return flanges, less than 8" thick up to 15' high

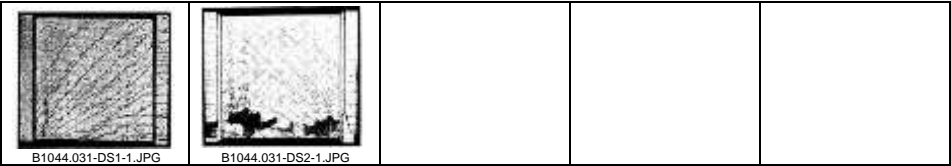
Description Costing for each 144 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Line 195

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	SF 144				
Demand Parameter (unit):	Story Drift Ratio	Unit less			
Number of Damage States:	2				
Damage State:	DS1	DS2			
Type of Damage State:	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.		Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	NO	

Illustrations



Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.0076	0.0134			
Data dispersion, β_d :	0.33	0.45			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.35	0.45			

Correlation (Yes / No) NO

Directionality (Yes / No) YES

Quality Ratings

Data Quality Average

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft. lengths. (5) Install bars: a. 12#9 A706 bars in bz ea. end; mech splices to (E); b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/fdn at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt,

Long Lead Time (Yes / No) NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.19E+04	1.35E+04	1.67E+04	1.99E+04	2.29E+04	3.07E+04									
Best fit mean:	1.39E+04			2.41E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Cost (Min Qty, Max Qty)	1.68E+04 1.14E+04			2.86E+04 1.95E+04											
CV or beta (Min Qty, Max Qty)	0.14 0.14			0.18 0.18											
Quantity Unit:	144 ft^2 Units			144 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.29E+00	1.05E+01	1.30E+01	1.55E+01	1.79E+01	2.39E+01									
Best fit mean:	1.05E+01			1.79E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Time (Min Qty, Max Qty)	1.31E+01 8.92E+00			2.23E+01 1.52E+01											
CV or beta (Min Qty, Max Qty)	0.28 0.28			0.31 0.31											
Quantity Unit:	144 ft^2 Units			144 ft^2 Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	50% 0.50			25% 0.50											

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Andrew Whittaker

Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 144

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1044.032

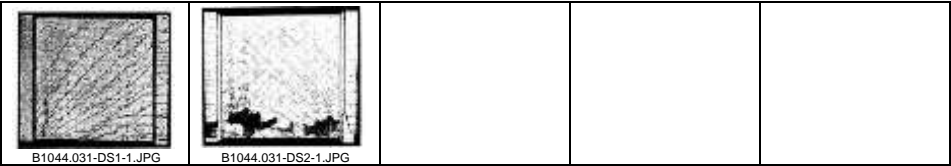
Low-rise reinforced concrete walls with return flanges, less than 8" thick, 16' to 24' high
Costing for each 400 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Line 196

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	SF 400				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	2				
Damage State:	DS1		DS2		
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.		Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	NO	

Illustrations



Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.0076	0.0134			
Data dispersion, β_d :	0.33	0.45			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.35	0.45			

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Average
Data Relevance Average
Documentation Quality Superior
Rationality Superior

Consequence Functions
Repair Description
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).
(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12#9 A706 bars in bz ea. end; mech splices to (E); b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/fdn at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt,

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.27E+04	3.65E+04	4.41E+04	5.56E+04	6.03E+04	8.31E+04									
Best fit mean:	3.75E+04			6.53E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Cost (Min Qty, Max Qty)	4.57E+04 3.10E+04			7.54E+04 5.13E+04											
CV or beta (Min Qty, Max Qty)	0.12 0.12			0.17 0.17											
Quantity Unit:	400 ft^2 Units			400 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.03E+01	3.38E+01	4.09E+01	5.15E+01	5.59E+01	7.70E+01									
Best fit mean:	3.38E+01			5.59E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Time (Min Qty, Max Qty)	4.23E+01 2.88E+01			6.99E+01 4.75E+01											
CV or beta (Min Qty, Max Qty)	0.28 0.28			0.30 0.30											
Quantity Unit:	400 ft^2 Units			400 ft^2 Units											
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	50% 0.50			25% 0.50											

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Andrew Whittaker
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 400

FEMA P-58 Fragility Specification

NISTIR Classification B1044.033

NISTIR Name Low-rise reinforced concrete walls with return flanges, less than 8" thick, 25' to 40' high

Description Costing for each 900 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Line 197

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	SF 900				
Demand Parameter (unit):	Story Drift Ratio	Unit less			
Number of Damage States:	2				
Damage State:	DS1	DS2			
Type of Damage State:	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.		Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.0076	0.0134			
Data dispersion, β_d :	0.33	0.45			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.35	0.45			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Average				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description					

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12#9 A706 bars in bz ea. end; mech splices to (E); b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/fdn at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt,

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	7.22E+04	7.76E+04	9.02E+04	1.00E+05	1.19E+05	1.50E+05									
Best fit mean:	7.97E+04			1.21E+05											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Cost (Min Qty, Max Qty)	9.70E+04 6.60E+04			1.48E+05 1.01E+05											
CV or beta (Min Qty, Max Qty)	0.09 0.09			0.16 0.16											
Quantity Unit:	900 ft^2 Units			900 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.90E+01	7.42E+01	8.62E+01	9.58E+01	1.13E+02	1.43E+02									
Best fit mean:	7.42E+01			1.13E+02											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Time (Min Qty, Max Qty)	9.27E+01 6.30E+01			1.42E+02 9.65E+01											
CV or beta (Min Qty, Max Qty)	0.27 0.27			0.30 0.30											
Quantity Unit:	900 ft^2 Units			900 ft^2 Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	50% 0.50			25% 0.50											

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Andrew Whittaker

Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 900

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1044.041

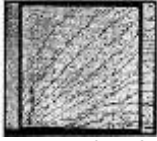
Low-rise reinforced concrete walls with return flanges, 8" to 16" thick up to 15' high
Costing for each 144 ft^2 Wall Panel, Orthogonal web reinforcement, $f_c > 2500$ psi, $P/(A \cdot f_c) \leq 0.2$

Line 198

Construction Quality:		Not Specified		<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>	
Seismic Installation Conditions:		Not Specified			
Fragility Unit of Measure:		SF 144			
Demand Parameter (unit):		Story Drift RatioUnit less			
Number of Damage States:		2			
Damage State:		DS1DS2			
Type of Damage State:		SequentialSequential			
DS Hierarchy		Seq(DS1,DS2)			
Descriptions		Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.		Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	NO	

Illustrations

				
B1044.031-DS1-1.JPG	B1044.031-DS2-1.JPG			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.0076	0.0134			
Data dispersion, β_d :	0.33	0.45			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.35	0.45			

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Average
Data Relevance Average
Documentation Quality Superior
Rationality Superior

Consequence Functions
Repair Description
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).
(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft. lengths. (5) Install bars: a. 12#9 A706 bars in bz ea. end; mech splices to (E); b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/fdn at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt,

Long Lead Time (Yes / No) NO NO

Repair Costs:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Cost by Damage State:	1.38E+04	1.53E+04	1.86E+04	2.54E+04	2.92E+04	3.60E+04									
Best fit mean:	1.58E+04			2.89E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Cost (Min Qty, Max Qty)	1.92E+04 1.30E+04			3.64E+04 2.48E+04											
CV or beta (Min Qty, Max Qty)	0.12 0.12			0.14 0.14											
Quantity Unit:	144 ft^2 Units			144 ft^2 Units											
Repair Time:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Time by Damage State:	1.07E+01	1.19E+01	1.45E+01	1.98E+01	2.27E+01	2.81E+01									
Best fit mean:	1.19E+01			2.27E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Time (Min Qty, Max Qty)	1.49E+01 1.01E+01			2.84E+01 1.93E+01											
CV or beta (Min Qty, Max Qty)	0.28 0.28			0.29 0.29											
Quantity Unit:	144 ft^2 Units			144 ft^2 Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	50% 0.50			25% 0.50											

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Andrew Whittaker
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 144

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1044.042

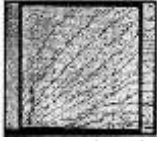
Low-rise reinforced concrete walls with return flanges, 8" to 16" thick, 16' to 24' high
Costing for each 400 ft^2 Wall Panel, Orthogonal web reinforcement, $f_c > 2500$ psi, $P/(A \cdot f_c) \leq 0.2$

Line 199

Construction Quality:		Not Specified		<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>	
Seismic Installation Conditions:		Not Specified			
Fragility Unit of Measure:		SF 400			
Demand Parameter (unit):		Story Drift RatioUnit less			
Number of Damage States:		2			
Damage State:		DS1		DS2	
Type of Damage State:		Sequential		Sequential	
DS Hierarchy		Seq(DS1,DS2)			
Descriptions		Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.		Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Illustrations

				
B1044.031-DS1-1.JPG	B1044.031-DS2-1.JPG			
1.00	1.00			

Damage State Probability:	1.00		1.00				
Fragility Parameters							
Median Demand, θ :						0.0076	0.0134
Data dispersion, β_d :						0.33	0.45
Uncertainty, β_u :						0.1	0.1
Total Dispersion, β :						0.35	0.45
Correlation (Yes / No)	NO						
Directionality (Yes / No)	YES						
Quality Ratings							
Data Quality	Average						
Data Relevance	Average						
Documentation Quality	Superior						
Rationality	Superior						
Consequence Functions							
Repair Description	Remove furnishings, ceilings and (1) Relocate eqpt. & furniture within 10						

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12#9 A706 bars in bz ea. end; mech splices to (E); b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/fdn at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt,

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.79E+04	4.17E+04	4.93E+04	6.90E+04	7.76E+04	1.00E+05									
Best fit mean:	4.27E+04			8.12E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00									
Average Repair Cost (Min Qty, Max Qty)	5.21E+04		3.54E+04	9.71E+04		6.60E+04									
CV or beta (Min Qty, Max Qty)	0.11		0.11	0.15		0.15									
Quantity Unit:	400 ft² Units			400 ft² Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.51E+01	3.86E+01	4.57E+01	6.39E+01	7.19E+01	9.29E+01									
Best fit mean:	3.86E+01			7.19E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00									
Average Repair Time (Min Qty, Max Qty)	4.83E+01		3.28E+01	8.99E+01		6.11E+01									
CV or beta (Min Qty, Max Qty)	0.27		0.27	0.29		0.29									
Quantity Unit:	400 ft² Units			400 ft² Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	50%	0.50		25%	0.50										

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Andrew Whittaker
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 400

FEMA P-58 Fragility Specification

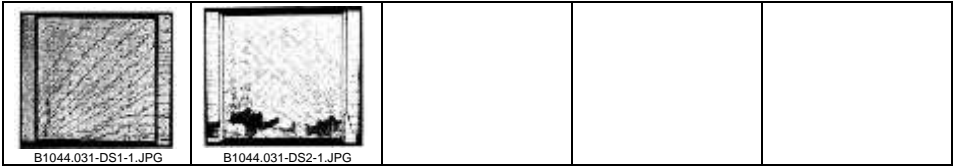
NISTIR Classification B1044.043
NISTIR Name Low-rise reinforced concrete walls with return flanges, 8" to 16" thick, 25' to 40' high
Description Costing for each 900 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Line 200

Construction Quality:	Not Specified	
Seismic Installation Conditions:	Not Specified	
Fragility Unit of Measure:	SF 900	
Demand Parameter (unit):	Story Drift Ratio	Unit less
Number of Damage States:	2	
Damage State:	DS1	DS2
Type of Damage State:	Sequential	Sequential
DS Hierarchy	Seq(DS1,DS2)	
Descriptions	Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.	Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.0076	0.0134			
Data dispersion, β_d :	0.33	0.45			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.35	0.45			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Average				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description					

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12#9 A706 bars in bz ea. end; mech splices to (E); b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/fdn at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt,

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	8.39E+04	8.93E+04	1.02E+05	1.24E+05	1.52E+05	1.82E+05									
Best fit mean:	9.13E+04			1.53E+05											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Cost (Min Qty, Max Qty)	1.12E+05 7.59E+04			1.90E+05 1.29E+05											
CV or beta (Min Qty, Max Qty)	0.08 0.08			0.15 0.15											
Quantity Unit:	900 ft^2 Units			900 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.02E+01	8.53E+01	9.74E+01	1.19E+02	1.45E+02	1.74E+02									
Best fit mean:	8.53E+01			1.45E+02											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Time (Min Qty, Max Qty)	1.07E+02 7.25E+01			1.81E+02 1.23E+02											
CV or beta (Min Qty, Max Qty)	0.26 0.26			0.29 0.29											
Quantity Unit:	900 ft^2 Units			900 ft^2 Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	50% 0.50			25% 0.50											

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Andrew Whittaker
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 900

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1044.051

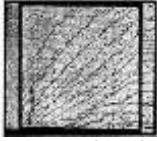

Low-rise reinforced concrete walls with return flanges, 17" to 24" thick" up to 15' high
Costing for each 144 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Line 201

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	SF 144					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.		Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.			

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	NO	

Illustrations

				
B1044.031-DS1-1.JPG	B1044.031-DS2-1.JPG			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.0076	0.0134			
Data dispersion, β_d :	0.33	0.45			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.35	0.45			

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Average
Data Relevance Average
Documentation Quality Superior
Rationality Superior

Consequence Functions
Repair Description
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).
(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12#9 A706 bars in bz ea. end; mech splices to (E); b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/fdn at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt,

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.69E+04	1.84E+04	2.17E+04	3.17E+04	3.69E+04	4.33E+04									
Best fit mean:	1.89E+04			3.70E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Cost (Min Qty, Max Qty)	1.92E+04 1.30E+04			3.77E+04 2.56E+04											
CV or beta (Min Qty, Max Qty)	0.10 0.10			0.12 0.12											
Quantity Unit:	144 ft^2 Units			144 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.07E+01	1.19E+01	1.45E+01	2.01E+01	2.35E+01	2.94E+01									
Best fit mean:	1.19E+01			2.35E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Time (Min Qty, Max Qty)	1.49E+01 1.01E+01			2.94E+01 2.00E+01											
CV or beta (Min Qty, Max Qty)	0.27 0.27			0.28 0.28											
Quantity Unit:	144 ft^2 Units			144 ft^2 Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	50% 0.50			25% 0.50											

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Andrew Whittaker
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 144

FEMA P-58 Fragility Specification

NISTIR Classification B1044.052
NISTIR Name Low-rise reinforced concrete walls with return flanges, 17" to 24" thick, 16' to 24' high
Description Costing for each 400 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Line 202

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	SF 400				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	2				
Damage State:	DS1		DS2		
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.		Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Illustrations



Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.0076	0.0134			
Data dispersion, β_d :	0.33	0.45			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.35	0.45			

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Average
Data Relevance Average
Documentation Quality Superior
Rationality Superior

Consequence Functions
Repair Description
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).
(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12#9 A706 bars in bz ea. end; mech splices to (E); b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/fdn at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt,

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	4.65E+04	5.03E+04	5.79E+04	8.66E+04	9.92E+04	1.18E+05									
Best fit mean:	5.13E+04			1.00E+05											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Cost (Min Qty, Max Qty)	6.29E+04 4.28E+04			1.24E+05 8.43E+04											
CV or beta (Min Qty, Max Qty)	0.09 0.09			0.12 0.12											
Quantity Unit:	400 ft^2 Units			400 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	4.31E+01	4.66E+01	5.36E+01	8.02E+01	9.19E+01	1.09E+02									
Best fit mean:	4.66E+01			9.19E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Time (Min Qty, Max Qty)	5.83E+01 3.96E+01			1.15E+02 7.81E+01											
CV or beta (Min Qty, Max Qty)	0.26 0.26			0.28 0.28											
Quantity Unit:	400 ft^2 Units			400 ft^2 Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	50% 0.50			25% 0.50											

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Andrew Whittaker
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 400

FEMA P-58 Fragility Specification

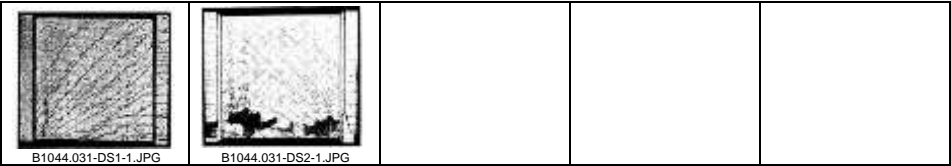
NISTIR Classification B1044.053
NISTIR Name Low-rise reinforced concrete walls with return flanges, 17" to 24" thick, 25' to 40' high
Description Costing for each 900 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Line 203

Construction Quality:	Not Specified	
Seismic Installation Conditions:	Not Specified	
Fragility Unit of Measure:	SF 900	
Demand Parameter (unit):	Story Drift Ratio	Unit less
Number of Damage States:	2	
Damage State:	DS1	DS2
Type of Damage State:	Sequential	Sequential
DS Hierarchy	Seq(DS1,DS2)	
Descriptions	Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.	Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	No	

Illustrations



Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.0076	0.0134			
Data dispersion, β_d :	0.33	0.45			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.35	0.45			

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Average
Data Relevance Average
Documentation Quality Superior
Rationality Superior

Consequence Functions
Repair Description
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).
(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12#9 A706 bars in bz ea. end; mech splices to (E); b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/fdn at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt,

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.03E+05	1.09E+05	1.21E+05	1.57E+05	1.93E+05	2.26E+05									
Best fit mean:	1.11E+05			1.82E+05											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Cost (Min Qty, Max Qty)	1.36E+05 9.23E+04			2.42E+05 1.64E+05											
CV or beta (Min Qty, Max Qty)	0.06 0.06			0.14 0.14											
Quantity Unit:	900 ft^2 Units			900 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.86E+01	1.04E+02	1.16E+02	1.50E+02	1.85E+02	2.16E+02									
Best fit mean:	1.04E+02			1.85E+02											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Time (Min Qty, Max Qty)	1.30E+02 8.82E+01			2.31E+02 1.57E+02											
CV or beta (Min Qty, Max Qty)	0.26 0.26			0.29 0.29											
Quantity Unit:	900 ft^2 Units			900 ft^2 Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	50% 0.50			25% 0.50											

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Andrew Whittaker
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 900


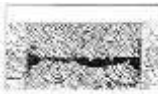
FEMA P-58 Fragility Specification

NISTIR Classification B1044.061
NISTIR Name Low rise reinforced concrete walls with boundary columns, less than 8" thick, height <15'
Description Costing for each 144 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Line 204

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	SF 144					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.		Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.			

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	NO	

Illustrations					
	B1044.061-DS1-1.JPG	B1044.061-DS2-1.JPG			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.0033	0.0087			
Data dispersion, β_d :	0.33	0.18			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.35	0.2			

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Average
Data Relevance Average
Documentation Quality Superior
Rationality Superior

Consequence Functions
Repair Description
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).
(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12#9 A706 bars in bz ea. end; mech splices to (E); b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/fdn at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt,

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.19E+04	1.35E+04	1.67E+04	1.99E+04	2.29E+04	3.07E+04									
Best fit mean:	1.39E+04			2.41E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Cost (Min Qty, Max Qty)	1.68E+04 1.14E+04			2.86E+04 1.95E+04											
CV or beta (Min Qty, Max Qty)	0.14 0.14			0.18 0.18											
Quantity Unit:	144 ft^2 Units			144 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.29E+00	1.05E+01	1.30E+01	1.55E+01	1.79E+01	2.39E+01									
Best fit mean:	1.05E+01			1.79E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Time (Min Qty, Max Qty)	1.31E+01 8.92E+00			2.23E+01 1.52E+01											
CV or beta (Min Qty, Max Qty)	0.28 0.28			0.31 0.31											
Quantity Unit:	144 ft^2 Units			144 ft^2 Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	50% 0.50			25% 0.50											

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Andrew Whittaker
Revisions: None

Root Cost Multiplier: 144


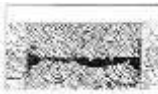
FEMA P-58 Fragility Specification

NISTIR Classification B1044.062
NISTIR Name Low rise reinforced concrete walls with boundary columns, less than 8" thick, height between 16'-24'
Description Costing for each 400 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Line 205

Construction Quality:		Not Specified		<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>	
Seismic Installation Conditions:		Not Specified			
Fragility Unit of Measure:		SF 400			
Demand Parameter (unit):		Story Drift RatioUnit less			
Number of Damage States:		2			
Damage State:		DS1		DS2	
Type of Damage State:		Sequential		Sequential	
DS Hierarchy		Seq(DS1,DS2)			
Descriptions		Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.		Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Illustrations	<div></div> <div></div> <div></div> <div></div> <div></div>				
	B1044.061-DS1-1.JPG		B1044.061-DS2-1.JPG		
Damage State Probability:	1.00		1.00		

Fragility Parameters					
Median Demand, θ :	0.0033		0.0087		
Data dispersion, β_d :	0.33		0.18		
Uncertainty, β_u :	0.1		0.1		
Total Dispersion, β :	0.35		0.2		

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Average
Data Relevance Average
Documentation Quality Superior
Rationality Superior

Consequence Functions
Repair Description
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).
(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12#9 A706 bars in bz ea. end; mech splices to (E); b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/fdn at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt,

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.27E+04	3.65E+04	4.41E+04	5.56E+04	6.03E+04	8.31E+04									
Best fit mean:	3.75E+04			6.53E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00									
Average Repair Cost (Min Qty, Max Qty)	4.57E+04		3.10E+04	7.54E+04		5.13E+04									
CV or beta (Min Qty, Max Qty)	0.12		0.12	0.17		0.17									
Quantity Unit:	400 ft^2 Units			400 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.03E+01	3.38E+01	4.09E+01	5.15E+01	5.59E+01	7.70E+01									
Best fit mean:	3.38E+01			5.59E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00									
Average Repair Time (Min Qty, Max Qty)	4.23E+01		2.88E+01	6.99E+01		4.75E+01									
CV or beta (Min Qty, Max Qty)	0.28		0.28	0.30		0.30									
Quantity Unit:	400 ft^2 Units			400 ft^2 Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	50%	0.50		25%	0.50										

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Andrew Whittaker
Revisions: None

Root Cost Multiplier: 400


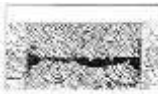
FEMA P-58 Fragility Specification

NISTIR Classification B1044.063
NISTIR Name Low rise reinforced concrete walls with boundary columns, less than 8" thick, height between 24'-40'
Description Costing for each 900 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Line 206

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	SF 900				
Demand Parameter (unit):	Story Drift Ratio	Unit less			
Number of Damage States:	2				
Damage State:	DS1	DS2			
Type of Damage State:	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.		Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Illustrations					
					
	B1044.061-DS1-1.JPG	B1044.061-DS2-1.JPG			
Damage State Probability:	1.00		1.00		

Fragility Parameters					
Median Demand, θ :	0.0033	0.0087			
Data dispersion, β_d :	0.33	0.18			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.35	0.2			

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Average
Data Relevance Average
Documentation Quality Superior
Rationality Superior

Consequence Functions
Repair Description
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).
(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12#9 A706 bars in bz ea. end; mech splices to (E); b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/fdn at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt,

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	7.22E+04	7.76E+04	9.02E+04	1.00E+05	1.19E+05	1.50E+05									
Best fit mean:	7.97E+04			1.21E+05											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Cost (Min Qty, Max Qty)	9.70E+04 6.60E+04			1.48E+05 1.01E+05											
CV or beta (Min Qty, Max Qty)	0.09 0.09			0.16 0.16											
Quantity Unit:	900 ft^2 Units			900 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.90E+01	7.42E+01	8.62E+01	9.58E+01	1.13E+02	1.43E+02									
Best fit mean:	7.42E+01			1.13E+02											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Time (Min Qty, Max Qty)	9.27E+01 6.30E+01			1.42E+02 9.65E+01											
CV or beta (Min Qty, Max Qty)	0.27 0.27			0.30 0.30											
Quantity Unit:	900 ft^2 Units			900 ft^2 Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	50% 0.50			25% 0.50											

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Andrew Whittaker
Revisions: None
Root Cost Multiplier: 900

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1044.071

Low rise reinforced concrete walls with boundary columns, 8" to 16" thick, height <15'
Costing for each 144 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Line 207

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	SF 144				
Demand Parameter (unit):	Story Drift Ratio	Unit less			
Number of Damage States:	2				
Damage State:	DS1	DS2			
Type of Damage State:	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.		Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	NO	

Illustrations

				
B1044.061-DS1-1.JPG	B1044.061-DS2-1.JPG			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.0033	0.0087			
Data dispersion, β_d :	0.33	0.18			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.35	0.2			

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Average
Data Relevance Average
Documentation Quality Superior
Rationality Superior

Consequence Functions
Repair Description
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).
(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12#9 A706 bars in bz ea. end; mech splices to (E); b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/fdn at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt,

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.38E+04	1.53E+04	1.86E+04	2.57E+04	3.01E+04	3.77E+04									
Best fit mean:	1.58E+04			3.08E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00									
Average Repair Cost (Min Qty, Max Qty)	1.92E+04		1.30E+04	3.77E+04		2.56E+04									
CV or beta (Min Qty, Max Qty)	0.12		0.12	0.15		0.15									
Quantity Unit:	144 ft^2 Units			144 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.07E+01	1.19E+01	1.45E+01	2.01E+01	2.35E+01	2.94E+01									
Best fit mean:	1.19E+01			2.35E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00									
Average Repair Time (Min Qty, Max Qty)	1.49E+01		1.01E+01	2.94E+01		2.00E+01									
CV or beta (Min Qty, Max Qty)	0.28		0.28	0.29		0.29									
Quantity Unit:	144 ft^2 Units			144 ft^2 Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00									
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00									
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	50%		0.50	25%		0.50									

Root Cost Multiplier: 144

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1044.072


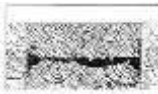
Low rise reinforced concrete walls with boundary columns, 8" to 16" thick, height between 16'-24'
Costing for each 400 ft^2 Wall Panel, Orthogonal web reinforcement, $f_c > 2500$ psi, $P/(A \cdot f_c) \leq 0.2$

Line 208

Construction Quality:		Not Specified		<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>	
Seismic Installation Conditions:		Not Specified			
Fragility Unit of Measure:		SF 400			
Demand Parameter (unit):		Story Drift RatioUnit less			
Number of Damage States:		2			
Damage State:		DS1DS2			
Type of Damage State:		SequentialSequential			
DS Hierarchy		Seq(DS1,DS2)			
Descriptions		Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.		Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	NO	

Illustrations

				
B1044.061-DS1-1.JPG	B1044.061-DS2-1.JPG			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.0033	0.0087			
Data dispersion, β_d :	0.33	0.18			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.35	0.2			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Average				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description					

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12#9 A706 bars in bz ea. end; mech splices to (E); b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/fdn at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt,

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.79E+04	4.17E+04	4.93E+04	6.90E+04	7.76E+04	1.00E+05									
Best fit mean:	4.27E+04			8.12E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Cost (Min Qty, Max Qty)	5.21E+04 3.54E+04			9.71E+04 6.60E+04											
CV or beta (Min Qty, Max Qty)	0.11 0.11			0.15 0.15											
Quantity Unit:	400 ft² Units			400 ft² Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.51E+01	3.86E+01	4.57E+01	6.39E+01	7.19E+01	9.29E+01									
Best fit mean:	3.86E+01			7.19E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Time (Min Qty, Max Qty)	4.83E+01 3.28E+01			8.99E+01 6.11E+01											
CV or beta (Min Qty, Max Qty)	0.27 0.27			0.29 0.29											
Quantity Unit:	400 ft² Units			400 ft² Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	50% 0.50			25% 0.50											

Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

Not Given
By User
By User
Andrew Whittaker
None

Root Cost Multiplier: 400

FEMA P-58 Fragility Specification

NISTIR Classification B1044.073

NISTIR Name Low rise reinforced concrete walls with boundary columns, 8" to 16" thick, height between 24'-40'


Description Costing for each 900 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Line 209

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	SF 900				
Demand Parameter (unit):	Story Drift Ratio	Unit less			
Number of Damage States:	2				
Damage State:	DS1	DS2			
Type of Damage State:	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.		Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
B1044.061-DS1-1.JPG	B1044.061-DS2-1.JPG			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.0033	0.0087			
Data dispersion, β_d :	0.33	0.18			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.35	0.2			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Average				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description					

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12#9 A706 bars in bz ea. end; mech splices to (E); b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/fdn at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt,

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	8.39E+04	8.93E+04	1.02E+05	1.24E+05	1.52E+05	1.82E+05									
Best fit mean:	9.13E+04			1.53E+05											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00									
Average Repair Cost (Min Qty, Max Qty)	1.12E+05		7.59E+04	1.90E+05		1.29E+05									
CV or beta (Min Qty, Max Qty)	0.08		0.08	0.15		0.15									
Quantity Unit:	900 ft^2 Units			900 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.02E+01	8.53E+01	9.74E+01	1.19E+02	1.45E+02	1.74E+02									
Best fit mean:	8.53E+01			1.45E+02											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00									
Average Repair Time (Min Qty, Max Qty)	1.07E+02		7.25E+01	1.81E+02		1.23E+02									
CV or beta (Min Qty, Max Qty)	0.26		0.26	0.29		0.29									
Quantity Unit:	900 ft^2 Units			900 ft^2 Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	50%	0.50		25%	0.50										

Root Cost Multiplier: 900

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1044.081


Low rise reinforced concrete walls with boundary columns, 17"-24" thick, height <15'
Costing for each 144 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Line 210

Construction Quality:		Not Specified		<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>	
Seismic Installation Conditions:		Not Specified			
Fragility Unit of Measure:		SF 144			
Demand Parameter (unit):		Story Drift RatioUnit less			
Number of Damage States:		2			
Damage State:		DS1DS2			
Type of Damage State:		SequentialSequential			
DS Hierarchy		Seq(DS1,DS2)			
Descriptions		Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.		Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	NO	

Illustrations

				
B1044.061-DS1-1.JPG	B1044.061-DS2-1.JPG			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.0033	0.0087			
Data dispersion, β_d :	0.33	0.18			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.35	0.2			

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Average
Data Relevance Average
Documentation Quality Superior
Rationality Superior

Consequence Functions
Repair Description
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).
(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12#9 A706 bars in bz ea. end; mech splices to (E); b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/fdn at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt,

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.69E+04	1.84E+04	2.17E+04	2.97E+04	3.55E+04	4.26E+04									
Best fit mean:	1.89E+04			3.56E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Cost (Min Qty, Max Qty)	2.30E+04 1.57E+04			4.44E+04 3.02E+04											
CV or beta (Min Qty, Max Qty)	0.10 0.10			0.14 0.14											
Quantity Unit:	144 ft^2 Units			144 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.32E+01	1.44E+01	1.69E+01	2.31E+01	2.77E+01	3.32E+01									
Best fit mean:	1.44E+01			2.77E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Time (Min Qty, Max Qty)	1.79E+01 1.22E+01			3.46E+01 2.36E+01											
CV or beta (Min Qty, Max Qty)	0.27 0.27			0.29 0.29											
Quantity Unit:	144 ft^2 Units			144 ft^2 Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	50% 0.50			25% 0.50											

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Andrew Whittaker
Revisions: None

Root Cost Multiplier: 144

FEMA P-58 Fragility Specification

NISTIR Classification B1044.082


NISTIR Name Low rise reinforced concrete walls with boundary columns, 17"-24" thick, height between 16'-24'

Description Costing for each 400 ft^2 Wall Panel, Orthogonal web reinforcement, $f_c > 2500$ psi, $P/(A \cdot f_c) \leq 0.2$

Line 211

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	SF 400					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.		Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.			

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Illustrations					
	B1044.061-DS1-1.JPG	B1044.061-DS2-1.JPG			
Damage State Probability:	1.00	1.00			

Fragility Parameters					
Median Demand, θ :	0.0033	0.0087			
Data dispersion, β_d :	0.33	0.18			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.35	0.2			

Correlation (Yes / No) NO

Directionality (Yes / No) YES

Quality Ratings

Data Quality Average

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12#9 A706 bars in bz ea. end; mech splices to (E); b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/fdn at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt,

Long Lead Time (Yes / No) NO NO

Repair Costs:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Cost by Damage State:	4.65E+04	5.03E+04	5.79E+04	8.66E+04	9.92E+04	1.18E+05									
Best fit mean:	5.13E+04			1.00E+05											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Cost (Min Qty, Max Qty)	6.29E+04 4.28E+04			1.24E+05 8.43E+04											
CV or beta (Min Qty, Max Qty)	0.09 0.09			0.12 0.12											
Quantity Unit:	400 ft^2 Units			400 ft^2 Units											
Repair Time:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Time by Damage State:	4.31E+01	4.66E+01	5.36E+01	8.02E+01	9.19E+01	1.09E+02									
Best fit mean:	4.66E+01			9.19E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Time (Min Qty, Max Qty)	5.83E+01 3.96E+01			1.15E+02 7.81E+01											
CV or beta (Min Qty, Max Qty)	0.26 0.26			0.28 0.28											
Quantity Unit:	400 ft^2 Units			400 ft^2 Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	50% 0.50			25% 0.50											

Comments: Full repair description does not fully fit on sheet - consider shortening. Description will fit in PACT.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Andrew Whittaker

Revisions: None

Root Cost Multiplier: 400

FEMA P-58 Fragility Specification

NISTIR Classification B1044.083


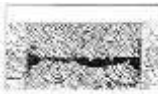
NISTIR Name Low rise reinforced concrete walls with boundary columns, 17"-24" thick, height between 24'-40'

Description Costing for each 900 ft^2 Wall Panel, Orthogonal web reinforcement, f'c > 2500 psi, P/(A*f'c) <= 0.2

Line 212

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	SF 900				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	2				
Damage State:	DS1		DS2		
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Crushed core concrete; localized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.		Sliding of the wall resulting in large residual displacement; distributed concrete cracking with widths greater than 0.12 in; fracture of rebar.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Illustrations					
					
	B1044.061-DS1-1.JPG	B1044.061-DS2-1.JPG			
Damage State Probability:	1.00		1.00		

Fragility Parameters					
Median Demand, θ :	0.0033		0.0087		
Data dispersion, β_d :	0.33		0.18		
Uncertainty, β_u :	0.1		0.1		
Total Dispersion, β :	0.35		0.2		

Correlation (Yes / No) NO

Directionality (Yes / No) YES

Quality Ratings

Data Quality Average

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

(1) Relocate eqpt. & furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12#9 A706 bars in bz ea. end; mech splices to (E); b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/fdn at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt,

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.03E+05	1.09E+05	1.21E+05	1.57E+05	1.93E+05	2.25E+05									
Best fit mean:	1.11E+05			1.92E+05											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Cost (Min Qty, Max Qty)	1.36E+05 9.23E+04			2.42E+05 1.64E+05											
CV or beta (Min Qty, Max Qty)	0.06 0.06			0.14 0.14											
Quantity Unit:	900 ft^2 Units			900 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.86E+01	1.04E+02	1.16E+02	1.50E+02	1.85E+02	2.15E+02									
Best fit mean:	1.04E+02			1.85E+02											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Time (Min Qty, Max Qty)	1.30E+02 8.82E+01			2.31E+02 1.57E+02											
CV or beta (Min Qty, Max Qty)	0.26 0.26			0.29 0.29											
Quantity Unit:	900 ft^2 Units			900 ft^2 Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00									
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00									
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	50%		0.50	25%		0.50									

Root Cost Multiplier: 900

FEMA P-58 Fragility Specification

NISTIR Classification B1044.091
NISTIR Name Slender Concrete Wall, 12" thick, 12' high, 15' long
Description Slender concrete shear wall with aspect ratio greater than or equal to 2.0. Costing assumes a 144 ft^2 wall panel.

Line 213

Construction Quality:	Not Specified			<div>Quantity Rounding</div> <div>Round Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? NO</div>
Seismic Installation Conditions:	Not applicable			
Fragility Unit of Measure:	SF 144			
Demand Parameter (unit):	Effective Drift			
Number of Damage States:	3			Unit less
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Spalling of cover, vertical cracks greater than 1/16 inch.	Exposed longitudinal reinforcing.	Core concrete damage, buckled reinforcing, fractured reinforcing, shear failure, web failure, bond slip	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	NO	

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0093	0.0128	0.0186		
Data dispersion, β_d :	0.465	0.33	0.43		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.5	0.35	0.45		

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Superior
Data Relevance Superior
Documentation Quality Superior
Rationality Superior

Consequence Functions
Repair Description Epoxy inject cracks and patch spalled concrete. Shore wall, remove all concrete in damaged regions, replace concrete. Replace wall or reinforce with R/C jacket if possible. Shore floor and wall, remove damaged concrete and steel within one development length of damaged region, replace removed concrete and steel.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Cost by Damage State:	4.40E+03	5.66E+03	9.85E+03	1.64E+04	2.14E+04	3.01E+04	3.66E+04	4.06E+04	5.38E+04						
Best fit mean:	6.20E+03			2.19E+04			4.31E+04								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00			3.00 7.00								
Average Repair Cost (Min Qty, Max Qty)	7.07E+03 0.35			2.67E+04 0.24			5.08E+04 0.16								
CV or beta (Min Qty, Max Qty)	0.35 0.35			0.24 0.24			0.16 0.16								
Quantity Unit:	144 ft^2 Units			144 ft^2 Units			144 ft^2 Units								
Repair Time:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Time by Damage State:	3.43E+00	4.41E+00	7.68E+00	1.28E+01	1.66E+01	2.35E+01	2.85E+01	3.17E+01	4.20E+01						
Best fit mean:	4.41E+00			1.66E+01			3.17E+01								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00			3.00 7.00								
Average Repair Time (Min Qty, Max Qty)	5.51E+00 0.43			2.08E+01 0.35			3.96E+01 0.30								
CV or beta (Min Qty, Max Qty)	0.43 0.43			0.35 0.35			0.30 0.30								
Quantity Unit:	144 ft^2 Units			144 ft^2 Units			144 ft^2 Units								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable								
Casualty-affected Planar Area (sf) per Normative Unit:	0%			0%			0%								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			25% 0.50			10% 0.50								

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 144

FEMA P-58 Fragility Specification

NISTIR Classification B1044.092
NISTIR Name Slender Concrete Wall, 12" thick, 12' high, 20' long
Description Slender concrete shear wall with aspect ratio greater than or equal to 2.0. Costing assumes a 144 ft^2 wall panel.

Line 214

Construction Quality:	Not Specified			Quantity Rounding Round Qty? NO Allow sum by floor or building? NO Demand Location (floor above)? NO
Seismic Installation Conditions:	Not applicable			
Fragility Unit of Measure:	SF 144			
Demand Parameter (unit):	Effective Drift	Unit less		
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Spalling of cover, vertical cracks greater than 1/16 inch.	Exposed longitudinal reinforcing.	Core concrete damage, buckled reinforcing, fractured reinforcing, shear failure, web failure, bond slip	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0093	0.0128	0.0186		
Data dispersion, β_d :	0.465	0.33	0.43		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.5	0.35	0.45		

Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Superior				
Data Relevance	Superior				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Epoxy inject cracks and patch spalled concrete.	Shore wall, remove all concrete in damaged regions, replace concrete.	Replace wall or reinforce with R/C jacket if possible. Shore floor and wall, remove damaged concrete and steel within one development length of damaged region, replace removed concrete and steel.		

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	4.14E+03	5.26E+03	8.65E+03	1.32E+04	1.71E+04	2.39E+04	3.58E+04	3.92E+04	5.09E+04						
Best fit mean:	5.70E+03			1.76E+04			4.15E+04								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00						
Average Repair Cost (Min Qty, Max Qty)	6.57E+03		4.47E+03	2.14E+04		1.46E+04	4.90E+04		3.33E+04						
CV or beta (Min Qty, Max Qty)	0.31		0.31	0.24		0.24	0.15		0.15						
Quantity Unit:	144 ft² Units			144 ft² Units			144 ft² Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.23E+00	4.09E+00	6.74E+00	1.03E+01	1.33E+01	1.87E+01	2.79E+01	3.06E+01	3.97E+01						
Best fit mean:	4.09E+00			1.33E+01			3.06E+01								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00						
Average Repair Time (Min Qty, Max Qty)	5.11E+00		3.48E+00	1.67E+01		1.13E+01	3.82E+01		2.60E+01						
CV or beta (Min Qty, Max Qty)	0.40		0.40	0.34		0.34	0.29		0.29						
Quantity Unit:	144 ft² Units			144 ft² Units			144 ft² Units								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00						
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00						
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	25%		0.50	10%		0.50						

Root Cost Multiplier: 144

FEMA P-58 Fragility Specification

NISTIR Classification B1044.093
NISTIR Name Slender Concrete Wall, 12" thick, 12' high, 30' long
Description Slender concrete shear wall with aspect ratio greater than or equal to 2.0. Costing assumes a 144 ft^2 wall panel.

Line 215

Construction Quality:	Not Specified			<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? NO</div>	
Seismic Installation Conditions:	Not applicable				
Fragility Unit of Measure:	SF 144				
Demand Parameter (unit):	Effective DriftUnit less				
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Spalling of cover, vertical cracks greater than 1/16 inch.	Exposed longitudinal reinforcing.	Core concrete damage, buckled reinforcing, fractured reinforcing, shear failure, web failure, bond slip		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0093	0.0128	0.0186		
Data dispersion, β_d :	0.465	0.33	0.43		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.5	0.35	0.45		

Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Superior				
Data Relevance	Superior				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Epoxy inject cracks and patch spalled concrete.	Shore wall, remove all concrete in damaged regions, replace concrete.	Replace wall or reinforce with R/C jacket if possible. Shore floor and wall, remove damaged concrete and steel within one development length of damaged region, replace removed concrete and steel.		

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.88E+03	4.86E+03	7.45E+03	9.08E+03	1.17E+04	1.63E+04	3.49E+04	3.78E+04	4.80E+04						
Best fit mean:	5.18E+03			1.20E+04			3.99E+04								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00						
Average Repair Cost (Min Qty, Max Qty)	6.07E+03		4.13E+03	1.46E+04		9.93E+03	4.73E+04		3.22E+04						
CV or beta (Min Qty, Max Qty)	0.27		0.27	0.24		0.24	0.13		0.13						
Quantity Unit:	144 ft^2 Units			144 ft^2 Units			144 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.02E+00	3.79E+00	5.80E+00	7.08E+00	9.10E+00	1.27E+01	2.72E+01	2.95E+01	3.75E+01						
Best fit mean:	3.79E+00			9.10E+00			2.95E+01								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00						
Average Repair Time (Min Qty, Max Qty)	4.73E+00		3.22E+00	1.14E+01		7.74E+00	3.69E+01		2.51E+01						
CV or beta (Min Qty, Max Qty)	0.37		0.37	0.34		0.34	0.28		0.28						
Quantity Unit:	144 ft^2 Units			144 ft^2 Units			144 ft^2 Units								
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00						
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00						
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	25%		0.50	10%		0.50						

Root Cost Multiplier: 144

FEMA P-58 Fragility Specification

NISTIR Classification B1044.101
NISTIR Name Slender Concrete Wall, 18" thick, 12' high, 15' long
Description Slender concrete shear wall with aspect ratio greater than or equal to 2.0. Costing assumes a 144 ft^2 wall panel.

Line 216

Construction Quality:	Not Specified				<div>Quantity Rounding</div> <div>Round Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? NO</div>
Seismic Installation Conditions:	Not applicable				
Fragility Unit of Measure:	SF 144				
Demand Parameter (unit):	Effective Drift		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Spalling of cover, vertical cracks greater than 1/16 inch.	Exposed longitudinal reinforcing.	Core concrete damage, buckled reinforcing, fractured reinforcing, shear failure, web failure, bond slip		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0093	0.0128	0.0186		
Data dispersion, β_d :	0.465	0.33	0.43		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.5	0.35	0.45		

Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Superior				
Data Relevance	Superior				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Epoxy inject cracks and patch spalled concrete.	Shore wall, remove all concrete in damaged regions, replace concrete.	Replace wall or reinforce with R/C jacket if possible. Shore floor and wall, remove damaged concrete and steel within one development length of damaged region, replace removed concrete and steel.		

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	6.82E+03	8.68E+03	1.35E+04	2.10E+04	3.00E+04	3.69E+04	4.02E+04	4.46E+04	5.86E+04						
Best fit mean:	9.24E+03			2.93E+04			4.71E+04								
Best Fit Distribution:	LogNormal			Normal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00			3.00 7.00								
Average Repair Cost (Min Qty, Max Qty)	1.09E+04 7.38E+03			3.75E+04 2.55E+04			5.57E+04 3.79E+04								
CV or beta (Min Qty, Max Qty)	0.28 0.28			0.21 0.21			0.16 0.16								
Quantity Unit:	144 ft² Units			144 ft² Units			144 ft² Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.31E+00	6.77E+00	1.05E+01	1.63E+01	2.34E+01	2.87E+01	3.13E+01	3.47E+01	4.57E+01						
Best fit mean:	6.77E+00			2.34E+01			3.47E+01								
Best Fit Distribution:	LogNormal			Normal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00			3.00 7.00								
Average Repair Time (Min Qty, Max Qty)	8.46E+00 5.75E+00			2.92E+01 1.99E+01			4.34E+01 2.95E+01								
CV or beta (Min Qty, Max Qty)	0.38 0.38			0.33 0.33			0.29 0.29								
Quantity Unit:	144 ft² Units			144 ft² Units			144 ft² Units								
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			25% 0.50			10% 0.50								

Root Cost Multiplier: 144



FEMA P-58 Fragility Specification

NISTIR Classification B1044.102
NISTIR Name Slender Concrete Wall, 18" thick, 12' high, 20' long
Description Slender concrete shear wall with aspect ratio greater than or equal to 2.0. Costing assumes a 144 ft^2 wall panel.

Line 217

Construction Quality:	Not Specified				<div>Quantity Rounding</div> <div>Round Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? NO</div>
Seismic Installation Conditions:	Not applicable				
Fragility Unit of Measure:	SF 144				
Demand Parameter (unit):	Effective Drift		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Spalling of cover, vertical cracks greater than 1/16 inch.	Exposed longitudinal reinforcing.	Core concrete damage, buckled reinforcing, fractured reinforcing, shear failure, web failure, bond slip		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Illustrations					
	B1044.091-DS1-1.JPG	B1044.091-DS2-1.JPG	B1044.091-DS3-1.JPG		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.0093	0.0128	0.0186		
Data dispersion, β_d :	0.465	0.33	0.43		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.5	0.35	0.45		

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Superior
Data Relevance Superior
Documentation Quality Superior
Rationality Superior

Consequence Functions
Repair Description Epoxy inject cracks and patch spalled concrete. Shore wall, remove all concrete in damaged regions, replace concrete. Replace wall or reinforce with R/C jacket if possible. Shore floor and wall, remove damaged concrete and steel within one development length of damaged region, replace removed concrete and steel.

Long Lead Time (Yes / No) NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	6.56E+03	8.28E+03	1.23E+04	1.73E+04	2.44E+04	3.00E+04	3.93E+04	4.32E+04	5.57E+04						
Best fit mean:	8.71E+03			2.39E+04			4.55E+04								
Best Fit Distribution:	LogNormal			Normal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00						
Average Repair Cost (Min Qty, Max Qty)	1.04E+04		7.04E+03	3.05E+04		2.08E+04	5.40E+04		3.67E+04						
CV or beta (Min Qty, Max Qty)	0.26		0.26	0.21		0.21	0.14		0.14						
Quantity Unit:	144 ft^2 Units			144 ft^2 Units			144 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.11E+00	6.45E+00	9.56E+00	1.35E+01	1.90E+01	2.34E+01	3.07E+01	3.37E+01	4.34E+01						
Best fit mean:	6.45E+00			1.90E+01			3.37E+01								
Best Fit Distribution:	LogNormal			Normal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00						
Average Repair Time (Min Qty, Max Qty)	8.06E+00		5.48E+00	2.38E+01		1.62E+01	4.21E+01		2.86E+01						
CV or beta (Min Qty, Max Qty)	0.36		0.36	0.32		0.32	0.29		0.29						
Quantity Unit:	144 ft^2 Units			144 ft^2 Units			144 ft^2 Units								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00						
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00						
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	25%		0.50	10%		0.50						

Root Cost Multiplier: 144

FEMA P-58 Fragility Specification

NISTIR Classification B1044.103
NISTIR Name Slender Concrete Wall, 18" thick, 12' high, 30' long
Description Slender concrete shear wall with aspect ratio greater than or equal to 2.0. Costing assumes a 144 ft^2 wall panel.

Line 218

Construction Quality:	Not Specified			<div>Quantity Rounding</div> <div>Round Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? NO</div>
Seismic Installation Conditions:	Not applicable			
Fragility Unit of Measure:	SF 144			
Demand Parameter (unit):	Effective Drift			
Number of Damage States:	3	Unit less		
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Spalling of cover, vertical cracks greater than 1/16 inch.	Exposed longitudinal reinforcing.	Core concrete damage, buckled reinforcing, fractured reinforcing, shear failure, web failure, bond slip	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	NO	

Illustrations



Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0093	0.0128	0.0186		
Data dispersion, β_d :	0.465	0.33	0.43		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.5	0.35	0.45		

Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Superior				
Data Relevance	Superior				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Epoxy inject cracks and patch spalled concrete.	Shore wall, remove all concrete in damaged regions, replace concrete.	Replace wall or reinforce with R/C jacket if possible. Shore floor and wall, remove damaged concrete and steel within one development length of damaged region, replace removed concrete and steel.		

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	6.30E+03	7.88E+03	1.11E+04	1.36E+04	1.89E+04	2.32E+04	3.85E+04	4.19E+04	5.29E+04						
Best fit mean:	8.18E+03			1.86E+04			4.40E+04								
Best Fit Distribution:	LogNormal			Normal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00			3.00 7.00								
Average Repair Cost (Min Qty, Max Qty)	9.85E+03			6.70E+03			2.36E+04			1.60E+04			0.00E+00		
CV or beta (Min Qty, Max Qty)	0.23			0.23			0.20			0.20			0.13		
Quantity Unit:	144 ft^2 Units			144 ft^2 Units			144 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	4.91E+00	6.15E+00	8.63E+00	1.06E+01	1.47E+01	1.81E+01	3.00E+01	3.26E+01	4.12E+01						
Best fit mean:	6.15E+00			1.47E+01			3.26E+01								
Best Fit Distribution:	LogNormal			Normal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00			3.00 7.00								
Average Repair Time (Min Qty, Max Qty)	7.68E+00			5.23E+00			1.84E+01			1.25E+01			3.26E+01		
CV or beta (Min Qty, Max Qty)	0.34			0.34			0.32			0.32			0.28		
Quantity Unit:	144 ft^2 Units			144 ft^2 Units			144 ft^2 Units								
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			25% 0.50			10% 0.50								

Root Cost Multiplier: 144

FEMA P-58 Fragility Specification

NISTIR Classification B1044.111
NISTIR Name Slender Concrete Wall, 30" thick, 12' high, 15' long
Description Slender concrete shear wall with aspect ratio greater than or equal to 2.0. Costing assumes a 144 ft^2 wall panel.

Line 219

Construction Quality:	Not Specified				<div>Quantity Rounding</div> <div>Round Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? NO</div>
Seismic Installation Conditions:	Not applicable				
Fragility Unit of Measure:	SF 144				
Demand Parameter (unit):	Effective Drift		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Spalling of cover, vertical cracks greater than 1/16 inch.	Exposed longitudinal reinforcing.	Core concrete damage, buckled reinforcing, fractured reinforcing, shear failure, web failure, bond slip		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Illustrations

				
B1044.091-DS1-1.JPG	B1044.091-DS2-1.JPG	B1044.091-DS3-1.JPG		
1.00	1.00	1.00		

Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0093	0.0128	0.0186		
Data dispersion, β_d :	0.465	0.33	0.43		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.5	0.35	0.45		

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Superior
Data Relevance Superior
Documentation Quality Superior
Rationality Superior

Consequence Functions
Repair Description Epoxy inject cracks and patch spalled concrete. Shore wall, remove all concrete in damaged regions, replace concrete. Replace wall or reinforce with R/C jacket if possible. Shore floor and wall, remove damaged concrete and steel within one development length of damaged region, replace removed concrete and steel.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.03E+04	1.30E+04	1.87E+04	2.83E+04	4.32E+04	4.80E+04	4.74E+04	5.26E+04	6.82E+04						
Best fit mean:	1.35E+04			3.98E+04			5.54E+04								
Best Fit Distribution:	LogNormal			Normal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00						
Average Repair Cost (Min Qty, Max Qty)	1.63E+04		1.11E+04	5.40E+04		3.67E+04	6.58E+04		4.47E+04						
CV or beta (Min Qty, Max Qty)	0.24		0.24	0.19		0.19	0.15		0.15						
Quantity Unit:	144 ft² Units			144 ft² Units			144 ft² Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.01E+00	1.01E+01	1.45E+01	2.21E+01	3.37E+01	3.74E+01	3.69E+01	4.10E+01	5.32E+01						
Best fit mean:	1.01E+01			3.37E+01			4.10E+01								
Best Fit Distribution:	LogNormal			Normal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00	3.00		7.00						
Average Repair Time (Min Qty, Max Qty)	1.27E+01		8.62E+00	4.21E+01		2.86E+01	5.12E+01		3.48E+01						
CV or beta (Min Qty, Max Qty)	0.35		0.35	0.32		0.32	0.29		0.29						
Quantity Unit:	144 ft² Units			144 ft² Units			144 ft² Units								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00						
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00						
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	25%		0.50	10%		0.50						

Root Cost Multiplier: 144

FEMA P-58 Fragility Specification

NISTIR Classification B1044.112
NISTIR Name Slender Concrete Wall, 30" thick, 12' high, 20' long
Description Slender concrete shear wall with aspect ratio greater than or equal to 2.0. Costing assumes a 144 ft^2 wall panel.

Line 220

Construction Quality:	Not Specified			
Seismic Installation Conditions:	Not applicable			
Fragility Unit of Measure:	SF 144			
Demand Parameter (unit):	Effective Drift		Unit less	
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Spalling of cover, vertical cracks greater than 1/16 inch.	Exposed longitudinal reinforcing.	Core concrete damage, buckled reinforcing, fractured reinforcing, shear failure, web failure, bond slip	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Illustrations

				
B1044.091-DS1-1.JPG	B1044.091-DS2-1.JPG	B1044.091-DS3-1.JPG		
1.00	1.00	1.00		

Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0093	0.0128	0.0186		
Data dispersion, β_d :	0.465	0.33	0.43		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.5	0.35	0.45		

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Superior
Data Relevance Superior
Documentation Quality Superior
Rationality Superior

Consequence Functions
Repair Description Epoxy inject cracks and patch spalled concrete. Shore wall, remove all concrete in damaged regions, replace concrete. Replace wall or reinforce with R/C jacket if possible. Shore floor and wall, remove damaged concrete and steel within one development length of damaged region, replace removed concrete and steel.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.00E+04	1.26E+04	1.75E+04	2.38E+04	3.55E+04	3.98E+04	4.65E+04	5.12E+04	6.53E+04						
Best fit mean:	1.30E+04			3.30E+04			5.38E+04								
Best Fit Distribution:	LogNormal			Normal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00			3.00 7.00								
Average Repair Cost (Min Qty, Max Qty)	1.58E+04 0.22 1.07E+04 0.22			4.44E+04 0.19 3.02E+04 0.19			6.40E+04 0.14 4.35E+04 0.14								
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	144 ft² Units			144 ft² Units			144 ft² Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	7.80E+00	9.82E+00	1.36E+01	1.85E+01	2.77E+01	3.10E+01	3.63E+01	3.99E+01	5.09E+01						
Best fit mean:	9.82E+00			2.77E+01			3.99E+01								
Best Fit Distribution:	LogNormal			Normal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00			3.00 7.00								
Average Repair Time (Min Qty, Max Qty)	1.23E+01 0.34 8.35E+00 0.34			3.46E+01 0.31 2.35E+01 0.31			4.99E+01 0.29 3.39E+01 0.29								
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	144 ft² Units			144 ft² Units			144 ft² Units								
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			25% 0.50			10% 0.50								

Root Cost Multiplier: 144




FEMA P-58 Fragility Specification

NISTIR Classification B1044.113
NISTIR Name Slender Concrete Wall, 30" thick, 12' high, 30' long
Description Slender concrete shear wall with aspect ratio greater than or equal to 2.0. Costing assumes a 144 ft^2 wall panel.

Line 221

Construction Quality:	Not Specified				<div>Quantity Rounding</div> <div>Round Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? NO</div>
Seismic Installation Conditions:	Not applicable				
Fragility Unit of Measure:	SF 144				
Demand Parameter (unit):	Effective Drift		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Spalling of cover, vertical cracks greater than 1/16 inch.	Exposed longitudinal reinforcing.	Core concrete damage, buckled reinforcing, fractured reinforcing, shear failure, web failure, bond slip		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Illustrations					
	B1044.091-DS1-1.JPG	B1044.091-DS2-1.JPG	B1044.091-DS3-1.JPG		

Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0093	0.0128	0.0186		
Data dispersion, β_d :	0.465	0.33	0.43		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.5	0.35	0.45		

Correlation (Yes / No)	NO
Directionality (Yes / No)	YES
Quality Ratings	
Data Quality	Superior
Data Relevance	Superior
Documentation Quality	Superior
Rationality	Superior
Consequence Functions	
Repair Description	Epoxy inject cracks and patch spalled concrete.
	Shore wall, remove all concrete in damaged regions, replace concrete.
	Replace wall or reinforce with R/C jacket if possible. Shore floor and wall, remove damaged concrete and steel within one development length of damaged region, replace removed concrete and steel.

Long Lead Time (Yes / No)	NO	NO	NO		
Repair Costs:	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}
Repair Cost by Damage State:	9.76E+03 1.22E+04 1.63E+04	1.92E+04 2.78E+04 3.16E+04	4.57E+04 4.98E+04 6.24E+04		
Best fit mean:	1.25E+04	2.62E+04	5.22E+04		
Best Fit Distribution:	LogNormal	Normal	LogNormal		
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00	3.00 7.00	3.00 7.00		
Average Repair Cost (Min Qty, Max Qty)	1.53E+04 1.04E+04	3.48E+04 2.37E+04	6.23E+04 4.24E+04		
CV or beta (Min Qty, Max Qty)	0.20 0.20	0.18 0.18	0.13 0.13		
Quantity Unit:	144 ft^2 Units	144 ft^2 Units	144 ft^2 Units		
Repair Time:	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}
Repair Time by Damage State:	7.60E+00 9.50E+00 1.27E+01	1.50E+01 2.17E+01 2.46E+01	3.56E+01 3.88E+01 4.87E+01		
Best fit mean:	9.50E+00	2.17E+01	3.88E+01		
Best Fit Distribution:	LogNormal	Normal	LogNormal		
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00	3.00 7.00	3.00 7.00		
Average Repair Time (Min Qty, Max Qty)	1.19E+01 8.08E+00	2.71E+01 1.84E+01	4.85E+01 3.30E+01		
CV or beta (Min Qty, Max Qty)	0.32 0.32	0.31 0.31	0.28 0.28		
Quantity Unit:	144 ft^2 Units	144 ft^2 Units	144 ft^2 Units		
LifeSafety Hazard:					
Potential non-collapse casualties? (Yes / No)	NO	NO	NO		
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable	Not Applicable	Not Applicable		
Serious Injury (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00		
Loss of Life (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00		
Post-event Tagging Flag:	NO	YES	YES		
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00	25% 0.50	10% 0.50		
Comments:	None				
Date Created:	Not Given				
Approved (YES / NO)?	By User				
Official (YES / NO) ?	By User				
Author:	Not Given				
Revisions:	2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.				

Root Cost Multiplier: 144

FEMA P-58 Fragility Specification

NISTIR Classification B1049.001a
NISTIR Name Reinforced concrete flat slabs- columns without shear reinforcing 0<Vg/Vo<.2, no continuity reinf
Description Costing per joint, minimum of 6" thick slab, maximum of 12" thick slab.

Line 222

Construction Quality:	Not Specified					Quantity Rounding Round Qty? YES Allow sum by floor or building? NO Demand Location (floor above)? No
Seismic Installation Conditions:	Not applicable					
Fragility Unit of Measure:	EA 1					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Yield strain of the slab flexural reinforcement has been exceeded, spalling of concrete may/may not occur, slab exhibits large enough crack widths to allow epoxy injection.		Punching occurs, causing significant spalling of concrete. Epoxy injection is no longer expected to be sufficient to restore the required strength and stiffness to the slab and the slab-column connection.			

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
					
	B1049.001a-DS1-1.JPG		B1049.001a-DS2-1.JPG		

Damage State Probability:	1.00		1.00		
Fragility Parameters					
Median Demand, θ :	0.025		0.04		
Data dispersion, β_d :	0.2		0.20		
Uncertainty, β_u :	0.2		0.2		
Total Dispersion, β :	0.25		0.25		

Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Average				
Data Relevance	Average				
Documentation Quality	Average				
Rationality	Superior				
Consequence Functions					
Repair Description	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).				
	Shore damaged area in the two stories below. Remove 100 square feet of concrete slab per column, preserving the slab reinforcement; lap splice 30 new 10 foot long rebar with existing rebar; place formwork; recast concrete slab; remove forms, replace and repair finishes; replace furnishings, ceilings, mechanical, electrical, and plumbing systems. Cracks wide enough to be grouted are included in the portion of slab to be demolished and recast.				

Long Lead Time (Yes / No)		NO			NO								
Repair Costs:		P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:		1.93E+04	3.62E+04	5.09E+04	3.43E+04	4.95E+04	7.67E+04						
Best fit mean:		3.55E+04			5.06E+04								
Best Fit Distribution:		Normal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)		3.00		7.00	3.00		7.00						
Average Repair Cost (Min Qty, Max Qty)		4.53E+04		3.08E+04	6.19E+04		4.21E+04						
CV or beta (Min Qty, Max Qty)		0.35		0.35	0.32		0.32						
Quantity Unit:		Each			Each								
Repair Time:		P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:		1.65E+01	3.09E+01	4.34E+01	2.93E+01	4.23E+01	6.54E+01						
Best fit mean:		3.09E+01			4.23E+01								
Best Fit Distribution:		Normal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)		3.00		7.00	3.00		7.00						
Average Repair Time (Min Qty, Max Qty)		3.86E+01		2.63E+01	5.28E+01		3.59E+01						
CV or beta (Min Qty, Max Qty)		0.43		0.43	0.41		0.41						
Quantity Unit:		Each			Each								
LifeSafety Hazard:													
Potential non-collapse casualties? (Yes / No)		NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:		Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)		0%	0.00		0%	0.00							
Post-event Tagging Flag:		NO			YES								
Unsafe Placard Trigger (Median, Dispersion)		0%	0.00		10%	0.50							
Comments:		None											
Date Created:		Not Given											
Approved (YES / NO)?		By User											
Official (YES / NO) ?		By User											
Author:		John Wallace											
Revisions:		None											
		Root Cost Multiplier: 1											

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1049.001b
NISTIR Name Reinforced concrete flat slabs- columns without shear reinforcing 0<Vg/Vo<.2, with continuity reinf
Description Costing per joint, minimum of 6" thick slab, maximum of 12" thick slab.

Line 223

Construction Quality:	Not Specified					Quantity Rounding Round Qty? YES Allow sum by floor or building? NO Demand Location (floor above)? No
Seismic Installation Conditions:	Not applicable					
Fragility Unit of Measure:	EA 1					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Yield strain of the slab flexural reinforcement has been exceeded, spalling of concrete may/may not occur, slab exhibits large enough crack widths to allow epoxy injection.		Punching occurs, causing significant spalling of concrete. Epoxy injection is no longer expected to be sufficient to restore the required strength and stiffness to the slab and the slab-column connection.			

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	B1049.001a-DS1-1.JPG	B1049.001a-DS2-1.JPG			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.025	0.04			
Data dispersion, β_d :	0.2	0.20			
Uncertainty, β_u :	0.2	0.2			
Total Dispersion, β :	0.25	0.25			

Correlation (Yes / No) NO
Directionality (Yes / No) NO

Quality Ratings
Data Quality Average
Data Relevance Average
Documentation Quality Average
Rationality Superior

Consequence Functions
Repair Description
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).
Prepare work area for epoxy injection, inject epoxy into 40 feet of crack (30 feet top, 10 bottom of slab) of crack per 100 square feet of floor panel. Fabricate new structural steel shear head (column capital) that attaches to the column beneath the slab.

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.93E+04	3.62E+04	5.09E+04	2.33E+04	4.02E+04	5.69E+04									
Best fit mean:	3.55E+04			4.01E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00									
Average Repair Cost (Min Qty, Max Qty)	4.53E+04		3.08E+04	5.03E+04		3.42E+04									
CV or beta (Min Qty, Max Qty)	0.35		0.35	0.33		0.33									
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.65E+01	3.09E+01	4.34E+01	1.99E+01	3.43E+01	4.85E+01									
Best fit mean:	3.09E+01			3.43E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00									
Average Repair Time (Min Qty, Max Qty)	3.86E+01		2.63E+01	4.29E+01		2.92E+01									
CV or beta (Min Qty, Max Qty)	0.43		0.43	0.41		0.41									
Quantity Unit:	Each			Each											
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		20%	0.50										

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1049.002a
NISTIR Name Reinforced concrete flat slabs- columns without shear reinforcing .2<Vg/Vo<.4, no continuity reinf
Description Costing is on a per joint basis.

Line 224

Construction Quality: ACI 318-56, ACI 318-63, ACI 318-89, ACI 318-95, ACI 318-99, ACI 318-05
Seismic Installation Conditions: Not applicable

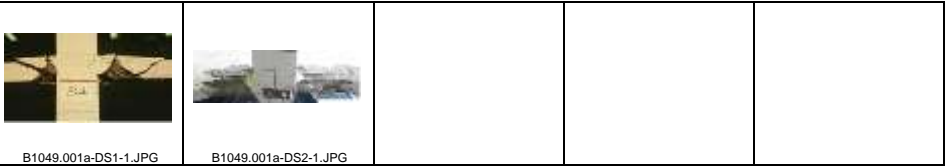
Fragility Unit of Measure: EA 1
Demand Parameter (unit): Story Drift Ratio Unit less

Number of Damage States: 2
Damage State: DS1 DS2
Type of Damage State: Sequential Sequential
DS Hierarchy Seq(DS1,DS2)

Descriptions
Yield strain of the slab flexural reinforcement has been exceeded, spalling of concrete may/may not occur, slab exhibits large enough crack widths to allow epoxy injection.
Punching occurs, causing significant spalling of concrete. Epoxy injection is no longer expected to be sufficient to restore the required strength and stiffness to the slab and the slab-column connection.

Quantity Rounding Round Qty? YES
Allow sum by floor or building? NO
Demand Location (floor above?) No

Illustrations



Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ:	0.02	0.035			
Data dispersion, β_d:	0.4	0.40			
Uncertainty, β_u:	0.1	0.1			
Total Dispersion, β:	0.4	0.4			

Correlation (Yes / No) NO
Directionality (Yes / No) NO

Quality Ratings
Data Quality Average
Data Relevance Average
Documentation Quality Average
Rationality Superior

Consequence Functions
Repair Description
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).
Shore damaged area in the two stories below. Remove 100 square feet of concrete slab per column, preserving the slab reinforcement; lap splice 30 new 10 foot long rebar with existing rebar; place formwork; recast concrete slab; remove forms, replace and repair finishes; replace furnishings, ceilings, mechanical, electrical, and plumbing systems Cracks wide enough to be grouted are included in the portion of slab to be demolished and recast.

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.93E+04	3.62E+04	5.09E+04	3.43E+04	4.95E+04	7.67E+04									
Best fit mean:	3.55E+04			5.06E+04											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Cost (Min Qty, Max Qty)	4.53E+04 3.08E+04			6.19E+04 4.21E+04											
CV or beta (Min Qty, Max Qty)	0.35 0.35			0.32 0.32											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.65E+01	3.09E+01	4.34E+01	2.93E+01	4.23E+01	6.54E+01									
Best fit mean:	3.09E+01			4.23E+01											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Time (Min Qty, Max Qty)	3.86E+01 2.63E+01			5.28E+01 3.59E+01											
CV or beta (Min Qty, Max Qty)	0.43 0.43			0.41 0.41											
Quantity Unit:	Each			Each											
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			10% 0.50											

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR ClassificationB1049.002b

NISTIR NameReinforced concrete flat slabs- columns without shear reinforcing .2<Vg/Vo<.4, with continuity reinf

DescriptionCosting is on a per joint basis.

Line 225

Construction Quality:	ACI 318-56, ACI 318-63, ACI 318-89, ACI 318-95, ACI 318-99, ACI 318-05					<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>	
Seismic Installation Conditions:	Not applicable						
Fragility Unit of Measure:	EA 1						
Demand Parameter (unit):	Story Drift Ratio		Unit less				
Number of Damage States:	2						
Damage State:	DS1		DS2				
Type of Damage State:	Sequential		Sequential				
DS Hierarchy	Seq(DS1,DS2)						
Descriptions	Yield strain of the slab flexural reinforcement has been exceeded, spalling of concrete may/may not occur, slab exhibits large enough crack widths to allow epoxy injection.		Punching occurs, causing significant spalling of concrete. Epoxy injection is no longer expected to be sufficient to restore the required strength and stiffness to the slab and the slab-column connection.				

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
					
	B1049.001a-DS1-1.JPG		B1049.001a-DS2-1.JPG		

Damage State Probability:	1.00		1.00						
Fragility Parameters									
Median Demand, θ :						0.02		0.035	
Data dispersion, β_d :						0.4		0.40	
Uncertainty, β_u :						0.1		0.1	
Total Dispersion, β :						0.4		0.4	
Correlation (Yes / No)	NO								
Directionality (Yes / No)	NO								
Quality Ratings									
Data Quality	Average								
Data Relevance	Average								
Documentation Quality	Average								
Rationality	Superior								
Consequence Functions									
Repair Description	Remove furnishings, ceilings and Prepare work area for epoxy injection,								

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Prepare work area for epoxy injection, inject epoxy into 40 feet of crack (30 feet top, 10 feet bottom of slab) per 100 square feet of floor panel. Fabricate new structural steel shear head (column capital) that attaches to the column beneath the slab.

Long Lead Time (Yes / No)	NO			NO											
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.93E+04	3.62E+04	5.09E+04	2.33E+04	4.02E+04	5.69E+04									
Best fit mean:	3.55E+04			4.01E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00									
Average Repair Cost (Min Qty, Max Qty)	4.53E+04		3.08E+04	5.03E+04		3.42E+04									
CV or beta (Min Qty, Max Qty)	0.35		0.35	0.33		0.33									
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.65E+01	3.09E+01	4.34E+01	1.99E+01	3.43E+01	4.85E+01									
Best fit mean:	3.09E+01			3.43E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00									
Average Repair Time (Min Qty, Max Qty)	3.86E+01		2.63E+01	4.29E+01		2.92E+01									
CV or beta (Min Qty, Max Qty)	0.43		0.43	0.41		0.41									
Quantity Unit:	Each			Each											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		20%	0.50										
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	John Wallace														
Revisions:	None														
	Root Cost Multiplier: 1														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1049.003a
NISTIR Name Reinforced concrete flat slabs- columns without shear reinforcing .4<Vg/Vo<.6, no continuity reinf
Description Costing is on a per joint basis.

Line 226


Construction Quality: ACI 318-63, ACI 318-83, ACI 318-99, ACI 318-02, CAN3-A23.2-M84, A23.3 & MC-90
Seismic Installation Conditions: Not applicable

Fragility Unit of Measure:	EA 1
Demand Parameter (unit):	Story Drift Ratio Unit less
Number of Damage States:	2

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Damage State:	DS1	DS2			
Type of Damage State:	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Yield strain of the slab flexural reinforcement has been exceeded, spalling of concrete may/may not occur, slab exhibits large enough crack widths to allow epoxy injection.	Punching occurs, causing significant spalling of concrete. Epoxy injection is no longer expected to be sufficient to restore the required strength and stiffness to the slab and the slab-column connection.			

Illustrations

				
B1049.001a-DS1-1.JPG	B1049.001a-DS2-1.JPG			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ:	0.012	0.016			
Data dispersion, β_d:	0.4	0.40			
Uncertainty, β_u:	0.1	0.1			
Total Dispersion, β:	0.4	0.4			

Correlation (Yes / No) NO
Directionality (Yes / No) NO

Quality Ratings
Data Quality Average
Data Relevance Average
Documentation Quality Average
Rationality Superior

Consequence Functions
Repair Description Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).
Shore damaged area in the two stories below. Remove 100 square feet of concrete slab per column, preserving the slab reinforcement; lap splice 30 new 10 foot long rebar with existing rebar; place formwork; recast concrete slab; remove forms, replace and repair finishes; replace furnishings, ceilings, mechanical, electrical, and plumbing systems. Cracks wide enough to be grouted are included in the portion of slab to be demolished and recast.

Long Lead Time (Yes / No) NO NO

Repair Costs:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Cost by Damage State:	1.99E+04	3.68E+04	5.15E+04	3.43E+04	4.95E+04	7.67E+04									
Best fit mean:	3.61E+04			5.06E+04											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00									
Average Repair Cost (Min Qty, Max Qty)	4.60E+04		3.13E+04	6.19E+04		4.21E+04									
CV or beta (Min Qty, Max Qty)	0.34		0.34	0.32		0.32									
Quantity Unit:	Each			Each											
Repair Time:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Time by Damage State:	1.70E+01	3.14E+01	4.39E+01	2.93E+01	4.23E+01	6.54E+01									
Best fit mean:	3.14E+01			4.23E+01											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00									
Average Repair Time (Min Qty, Max Qty)	3.93E+01		2.67E+01	5.28E+01		3.59E+01									
CV or beta (Min Qty, Max Qty)	0.42		0.42	0.41		0.41									
Quantity Unit:	Each			Each											
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		10%	0.50										
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	John Wallace														
Revisions:	None														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B1049.003b
NISTIR Name Reinforced concrete flat slabs- columns without shear reinforcing .4<Vg/Vo<.6, with continuity reinf
Description Costing is on a per joint basis.

Line 227



Construction Quality: ACI 318-63, ACI 318-83, ACI 318-99, ACI 318-02, CAN3-A23.2-M84, A23.3 & MC-90
Seismic Installation Conditions: Not applicable

Fragility Unit of Measure:	EA 1
Demand Parameter (unit):	Story Drift Ratio Unit less
Number of Damage States:	2

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Damage State:	DS1	DS2			
Type of Damage State:	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Yield strain of the slab flexural reinforcement has been exceeded, punching occurs, causing significant spalling of concrete. Epoxy injection is no longer expected to be sufficient to restore the required strength and stiffness to the slab and the slab-column connection. spalling of concrete may/may not occur, no longer expected to be sufficient to restore the required strength and stiffness to the slab and the slab-column connection. slab exhibits large enough crack widths to allow epoxy injection.				

Illustrations

				
B1049.001a-DS1-1.JPG	B1049.001a-DS2-1.JPG			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ:	0.012	0.016			
Data dispersion, β_d:	0.4	0.40			
Uncertainty, β_u:	0.1	0.1			
Total Dispersion, β:	0.4	0.4			

Correlation (Yes / No) NO
Directionality (Yes / No) NO

Quality Ratings
Data Quality Average
Data Relevance Average
Documentation Quality Average
Rationality Superior

Consequence Functions
Repair Description Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary). Prepare work area for epoxy injection, inject epoxy into 55 feet of crack (40 feet top, 15 feet bottom of slab) per 100 square feet of floor panel. Fabricate new structural steel shear head (column capital) that attaches to the column beneath the slab.

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.99E+04	3.68E+04	5.15E+04	2.39E+04	4.08E+04	5.75E+04									
Best fit mean:	3.61E+04			4.07E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00									
Average Repair Cost (Min Qty, Max Qty)	4.60E+04		3.13E+04	5.10E+04		3.47E+04									
CV or beta (Min Qty, Max Qty)	0.34		0.34	0.32		0.32									
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.70E+01	3.14E+01	4.39E+01	2.04E+01	3.48E+01	4.90E+01									
Best fit mean:	3.14E+01			3.48E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00									
Average Repair Time (Min Qty, Max Qty)	3.93E+01		2.67E+01	4.35E+01		2.96E+01									
CV or beta (Min Qty, Max Qty)	0.42		0.42	0.41		0.41									
Quantity Unit:	Each			Each											
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00									
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00									
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	20%		0.50									

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1049.011

Reinforced concrete flat slabs- columns with shear reinforcing 0.2<Vg/Vo<0.4
Costing is on a per joint basis.

Line 228



Construction Quality: ACI 318-71, ACI 318-95, ACI 318-99, ACI 318-05
Seismic Installation Conditions: Not applicable

Fragility Unit of Measure:	EA 1
Demand Parameter (unit):	Story Drift Ratio Unit less
Number of Damage States:	2

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Damage State:	DS1	DS2			
Type of Damage State:	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Yield strain of the slab flexural reinforcement has been exceeded, spalling of concrete may/may not occur, slab exhibits large enough crack widths to allow epoxy injection.	Punching occurs, causing significant spalling of concrete. Epoxy injection is no longer expected to be sufficient to restore the required strength and stiffness to the slab and the slab-column connection.			

Illustrations

				
B1049.001a-DS1-1.JPG	B1049.001a-DS2-1.JPG			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.03	0.048			
Data dispersion, β_d :	0.35	0.46			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.4	0.4			

Correlation (Yes / No) NO
Directionality (Yes / No) NO

Quality Ratings
Data Quality Average
Data Relevance Average
Documentation Quality Average
Rationality Superior

Consequence Functions
Repair Description
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).
Prepare work area for epoxy injection, inject epoxy into 70 feet of crack (50 feet top, 20 feet bottom of slab) per 100 square feet of floor panel. Fabricate new structural steel shear head (column capital) that attaches to the column beneath the slab.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.05E+04	3.74E+04	5.21E+04	2.45E+04	4.14E+04	5.81E+04									
Best fit mean:	3.67E+04			4.13E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00									
Average Repair Cost (Min Qty, Max Qty)	4.68E+04		3.18E+04	5.18E+04		3.52E+04									
CV or beta (Min Qty, Max Qty)	0.34		0.34	0.32		0.32									
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.75E+01	3.19E+01	4.44E+01	2.09E+01	3.53E+01	4.96E+01									
Best fit mean:	3.19E+01			3.53E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00									
Average Repair Time (Min Qty, Max Qty)	3.99E+01		2.71E+01	4.42E+01		3.00E+01									
CV or beta (Min Qty, Max Qty)	0.42		0.42	0.40		0.40									
Quantity Unit:	Each			Each											
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00									
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00									
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	20%		0.50									

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification
NISTIR Name
Description

B1049.012
Reinforced concrete flat slabs- columns with shear reinforcing 0.4<Vg/Vo<.6
Costing is on a per joint basis.

Line 229


Construction Quality: ACI-318-63, ACI-318-05, A23.3 & MC-90
Seismic Installation Conditions: Not applicable

Fragility Unit of Measure:	EA 1
Demand Parameter (unit):	Story Drift Ratio Unit less
Number of Damage States:	2

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Damage State:	DS1	DS2			
Type of Damage State:	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Yield strain of the slab flexural reinforcement has been exceeded, spalling of concrete may/may not occur, slab exhibits large enough crack widths to allow epoxy injection.	Punching occurs, causing significant spalling of concrete. Epoxy injection is no longer expected to be sufficient to restore the required strength and stiffness to the slab and the slab-column connection.			

Illustrations

				
B1049.001a-DS1-1.JPG	B1049.001a-DS2-1.JPG			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.022	0.03			
Data dispersion, β_d :	0.4	0.50			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.4	0.4			

Correlation (Yes / No) NO
Directionality (Yes / No) NO

Quality Ratings
Data Quality Average
Data Relevance Average
Documentation Quality Average
Rationality Superior

Consequence Functions
Repair Description
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).
Prepare work area for epoxy injection, inject epoxy into 85 feet of crack (60 feet top, 25 feet bottom of slab) per 100 square feet of floor panel. Fabricate new structural steel shear head (column capital) that attaches to the column beneath the slab.

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.11E+04	3.80E+04	5.27E+04	2.51E+04	4.20E+04	5.87E+04									
Best fit mean:	3.73E+04			4.19E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Cost (Min Qty, Max Qty)	4.75E+04 3.23E+04			5.25E+04 3.57E+04											
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.31 0.31											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.80E+01	3.24E+01	4.50E+01	2.14E+01	3.58E+01	5.01E+01									
Best fit mean:	3.24E+01			3.58E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Time (Min Qty, Max Qty)	4.05E+01 2.76E+01			4.48E+01 3.05E+01											
CV or beta (Min Qty, Max Qty)	0.41 0.41			0.40 0.40											
Quantity Unit:	Each			Each											
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			20% 0.50											

Comments: None
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: John Wallace
Revisions: 2011-08-24 DS 2 beta changed from 0.5 to 0.4 to avoid negative probability.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1049.021a

Post-tensioned concrete flat slabs- columns without shear reinforcing 0.2<Vg/Vo<0.4, no continuity reinf

Costing is on a per joint basis.

Line 230

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

ACI-318-77, ACI-318-89, ACI-318-05, IBC-03

Not applicable

EA 1

Story Drift Ratio

Unit less

2

DS1

Sequential

Seq(DS1,DS2)

Yield strain of the slab flexural reinforcement has been exceeded, spalling of concrete may/may not occur, slab exhibits large enough crack widths to allow epoxy injection.

DS2

Sequential

Punching occurs, causing significant spalling of concrete. Epoxy injection is no longer expected to be sufficient to restore the required strength and stiffness to the slab and the slab-column connection.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations



B1049.001a-DS1-1.JPG



B1049.001a-DS2-1.JPG

Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

0.018

0.39

0.1

0.4

NO

NO

Average

Average

Average

Superior

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Shore damaged area in the two stories below. Remove 100 square feet of concrete slab per column, preserving the slab reinforcement; lap splice 30 new 10 foot long rebar with existing rebar; place formwork; recast concrete slab; remove forms, replace and repair finishes; replace furnishings, ceilings, mechanical, electrical, and plumbing systems. Cracks wide enough to be grouted are included in the portion of slab to be demolished and recast.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

1.87E+04

3.56E+04

5.03E+04

P₁₀

P₅₀

P₉₀

3.49E+04

Normal

7.00

P₁₀

P₅₀

P₉₀

3.00

7.00

3.03E+04

P₁₀

P₅₀

P₉₀

4.45E+04

0.35

0.35

Each

P₁₀

P₅₀

P₉₀

3.43E+04

4.95E+04

7.67E+04

P₁₀

P₅₀

P₉₀

5.06E+04

LogNormal

7.00

P₁₀

P₅₀

P₉₀

6.19E+04

4.21E+04

0.32

P₁₀

P₅₀

P₉₀

2.93E+01

4.23E+01

6.54E+01

P₁₀

P₅₀

P₉₀

4.23E+01

LogNormal

7.00

P₁₀

P₅₀

P₉₀

3.80E+01

2.58E+01

0.41

P₁₀

P₅₀

P₉₀

0.43

0.43

0.41

Each

P₁₀

P₅₀

P₉₀

NO

NO

Not Applicable

P₁₀

P₅₀

P₉₀

0%

0.00

0%

P₁₀

P₅₀

P₉₀

0%

0.00

0%

P₁₀

P₅₀

P₉₀

NO

YES

P₁₀

P₅₀

P₉₀

0%

0.00

10%

None

Not Given

By User

By User

John Wallace

None

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1049.021b

Post-tensioned concrete flat slabs- columns without shear reinforcing 0.2<Vg/Vo<0.4, with continuity reinf
Costing is on a per joint basis.

Line 231


Construction Quality: ACI-318-77, ACI-318-89, ACI-318-05, IBC-03
Seismic Installation Conditions: Not applicable

Fragility Unit of Measure:	EA 1
Demand Parameter (unit):	Story Drift Ratio Unit less
Number of Damage States:	2

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Damage State:	DS1	DS2			
Type of Damage State:	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Yield strain of the slab flexural reinforcement has been exceeded, spalling of concrete may/may not occur, slab exhibits large enough crack widths to allow epoxy injection.	Punching occurs, causing significant spalling of concrete. Epoxy injection is no longer expected to be sufficient to restore the required strength and stiffness to the slab and the slab-column connection.			

Illustrations

				
B1049.001a-DS1-1.JPG	B1049.001a-DS2-1.JPG			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.018	0.03			
Data dispersion, β_d :	0.39	0.34			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.4	0.4			

Correlation (Yes / No) NO
Directionality (Yes / No) NO

Quality Ratings
Data Quality Average
Data Relevance Average
Documentation Quality Average
Rationality Superior

Consequence Functions
Repair Description
Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).
Prepare work area for epoxy injection, inject epoxy into 25 feet of crack (20 feet top, 5 feet bottom of slab) per 100 square feet of floor panel. Fabricate new structural steel shear head (column capital) that attaches to the column beneath the slab.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.87E+04	3.56E+04	5.03E+04	2.27E+04	3.96E+04	5.63E+04									
Best fit mean:	3.49E+04			3.95E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Cost (Min Qty, Max Qty)	4.45E+04 3.03E+04			4.95E+04 3.37E+04											
CV or beta (Min Qty, Max Qty)	0.35 0.35			0.33 0.33											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.60E+01	3.04E+01	4.29E+01	1.94E+01	3.38E+01	4.80E+01									
Best fit mean:	3.04E+01			3.38E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Time (Min Qty, Max Qty)	3.80E+01 2.58E+01			4.23E+01 2.87E+01											
CV or beta (Min Qty, Max Qty)	0.43 0.43			0.42 0.42											
Quantity Unit:	Each			Each											
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			20% 0.50											
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	John Wallace														
Revisions:	None														

Root Cost Multiplier: 1

Root Cost Multiplier: 1



FEMA P-58 Fragility Specification

NISTIR Classification B1049.022b
NISTIR Name Post-tensioned concrete flat slabs- columns without shear reinforcing 0.4<Vg/Vo<0.6, with continuity reinf
Description Costing is on a per joint basis.

Line 233

Construction Quality:	ACI-318-77, ACI-318-83, ACI-318-89, ACI-318-05				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not applicable				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	2				
Damage State:	DS1	DS2			
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Yield strain of the slab flexural reinforcement has been exceeded, spalling of concrete may/may not occur, slab exhibits large enough crack widths to allow epoxy injection.		Punching occurs, causing significant spalling of concrete. Epoxy injection is no longer expected to be sufficient to restore the required strength and stiffness to the slab and the slab-column connection.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	B1049.001a-DS1-1.JPG	B1049.001a-DS2-1.JPG			
Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.013	0.019			
Data dispersion, β_d :	0.45	0.53			
Uncertainty, β_u :	0.2	0.2			
Total Dispersion, β :	0.5	0.55			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Average				
Data Relevance	Average				
Documentation Quality	Average				
Rationality	Superior				
Consequence Functions					
Repair Description	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).		Prepare work area for epoxy injection, inject epoxy into 40 feet of crack (30 feet top, 10 feet bottom of slab) per 100 square feet of floor panel. Fabricate new structural steel shear head (column capital) that attaches to the column beneath the slab.		

Long Lead Time (Yes / No)	NO			NO											
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.93E+04	3.62E+04	5.09E+04	2.33E+04	4.02E+04	5.69E+04									
Best fit mean:	3.55E+04			4.01E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00									
Average Repair Cost (Min Qty, Max Qty)	4.35E+04		2.90E+04	4.83E+04		3.22E+04									
CV or beta (Min Qty, Max Qty)	0.35		0.35	0.33		0.33									
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.65E+01	3.09E+01	4.34E+01	1.99E+01	3.43E+01	4.85E+01									
Best fit mean:	3.09E+01			3.43E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00									
Average Repair Time (Min Qty, Max Qty)	3.71E+01		2.47E+01	4.12E+01		2.75E+01									
CV or beta (Min Qty, Max Qty)	0.43		0.43	0.41		0.41									
Quantity Unit:	Each			Each											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		20%	0.50										
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	John Wallace														
Revisions:	2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.														

Root Cost Multiplier: 1

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1049.031



Post-tensioned concrete flat slabs- columns with shear reinforcing 0<Vg/Vo<0.4
Costing is on a per joint basis.

Line 234

Construction Quality:	Not Specified				Quantity Rounding Round Qty? YES Allow sum by floor or building? NO Demand Location (floor above)? No
Seismic Installation Conditions:	Not applicable				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	2				
Damage State:	DS1		DS2		
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Yield strain of the slab flexural reinforcement has been exceeded, spalling of concrete may/may not occur, slab exhibits large enough crack widths to allow epoxy injection.		Punching occurs, causing significant spalling of concrete. Epoxy injection is no longer expected to be sufficient to restore the required strength and stiffness to the slab and the slab-column connection.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
B1049.001a-DS1-1.JPG	B1049.001a-DS2-1.JPG			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.028	0.04			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	0.5	0.5			
Total Dispersion, β :	0.5	0.5			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Average				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description					

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Prepare work area for epoxy injection, inject epoxy into 45 feet of crack (35 feet top, 10 feet bottom of slab) per 100 square feet of floor panel. Fabricate new structural steel shear head (column capital) that attaches to the column beneath the slab.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.95E+04	3.64E+04	5.11E+04	2.35E+04	4.04E+04	5.71E+04									
Best fit mean:	3.57E+04			4.03E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Cost (Min Qty, Max Qty)	4.37E+04			4.85E+04			3.23E+04								
CV or beta (Min Qty, Max Qty)	0.35 0.35			0.32 0.32											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.66E+01	3.11E+01	4.36E+01	2.00E+01	3.45E+01	4.87E+01									
Best fit mean:	3.11E+01			3.45E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00 7.00			3.00 7.00											
Average Repair Time (Min Qty, Max Qty)	3.73E+01			4.14E+01			2.76E+01								
CV or beta (Min Qty, Max Qty)	0.43 0.43			0.41 0.41											
Quantity Unit:	Each			Each											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			20% 0.50											

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1049.032


Post-tensioned concrete flat slabs- columns with shear reinforcing 0.4<Vg/Vo<.0.6
Costing is on a per joint basis.

Line 235

Construction Quality:	Not Specified	
Seismic Installation Conditions:	Not applicable	
Fragility Unit of Measure:	EA 1	
Demand Parameter (unit):	Story Drift Ratio	Unit less
Number of Damage States:	2	
Damage State:	DS1	DS2
Type of Damage State:	Sequential	Sequential
DS Hierarchy	Seq(DS1,DS2)	
Descriptions	Yield strain of the slab flexural reinforcement has been exceeded, spalling of concrete may/may not occur, slab exhibits large enough crack widths to allow epoxy injection.	Punching occurs, causing significant spalling of concrete. Epoxy injection is no longer expected to be sufficient to restore the required strength and stiffness to the slab and the slab-column connection.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
B1049.001a-DS1-1.JPG	B1049.001a-DS2-1.JPG			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.023	0.032			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	0.5	0.5			
Total Dispersion, β :	0.5	0.5			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Marginal				
Documentation Quality	Average				
Rationality	Superior				
Consequence Functions					
Repair Description	Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).	Prepare work area for epoxy injection, inject epoxy into 60 feet of crack (45 feet top, 15 feet bottom of slab) per 100 square feet of floor panel. Fabricate new structural steel shear head (column capital) that attaches to the column beneath the slab.			

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.01E+04	3.70E+04	5.17E+04	2.41E+04	4.10E+04	5.77E+04									
Best fit mean:	3.63E+04			4.09E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00									
Average Repair Cost (Min Qty, Max Qty)	4.44E+04		2.96E+04	4.92E+04		3.28E+04									
CV or beta (Min Qty, Max Qty)	0.34		0.34	0.32		0.32									
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.71E+01	3.16E+01	4.41E+01	2.06E+01	3.50E+01	4.92E+01									
Best fit mean:	3.16E+01			3.50E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	3.00		7.00	3.00		7.00									
Average Repair Time (Min Qty, Max Qty)	3.79E+01		2.53E+01	4.20E+01		2.80E+01									
CV or beta (Min Qty, Max Qty)	0.42		0.42	0.41		0.41									
Quantity Unit:	Each			Each											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		20%	0.50										
Comments:	Fragilities were based on judgment due to lack of test data.														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	John Wallace														
Revisions:	None														
	Root Cost Multiplier: 1														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1049.041b

Reinforced concrete flat slabs drop panel or drop capital- columns without shear reinforcing 0<Vg/Vo<0.4, with continuity reinf

Costing is on a per joint basis.

Line 237

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not applicable

EA 1

Story Drift Ratio

Unit less

2

DS1

Sequential

Seq(DS1,DS2)

Yield strain of the slab flexural reinforcement has been exceeded.

Punching occurs causing significant spalling of concrete.

Spalling of concrete may or may not occur. Slab exhibits large enough crack widths to allow epoxy injection.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

YES

NO

No

Illustrations



B1049.041a-DS1-1.JPG



B1049.041a-DS2-1.JPG

Damage State Probability:

Fragility Parameters

Median Demand, θ:

Data dispersion, β_d:

Uncertainty, β_u:

Total Dispersion, β:

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.00

1.00

0.025

Not Specified

0.5

0.5

0.042

Not Specified

0.5

0.5

NO

NO

Marginal

Marginal

Average

Superior

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Prepare work area for epoxy injection, inject epoxy into 40 feet of crack (30 feet top, 10 feet bottom of slab) per 100 square feet of floor panel. Fabricate new structural steel shear head (column capital) that attaches to the column beneath the slab.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.93E+04

3.62E+04

5.09E+04

2.33E+04

4.02E+04

5.69E+04

3.55E+04

Normal

3.00

7.00

4.35E+04

2.90E+04

0.35

0.35

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.65E+01

3.09E+01

4.34E+01

1.99E+01

3.43E+01

4.85E+01

3.09E+01

Normal

3.00

7.00

3.71E+01

2.47E+01

0.43

0.43

Each

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

NO

YES

0%

0.00

20%

0.50

Fragilities were based on judgment due to lack of test data. The only available data were from a specimen that was constructed using ACI 318-89

Not Given

By User

By User

John Wallace

None

Root Cost Multiplier:

1

Line 238

Reinforced concrete flat slabs drop panel or drop capital- columns without shear reinforcing $0.4 < V_g/V_o < 0.6$, no continuity reinforcement
Costing is on a per joint basis.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Spalling of concrete may or may not occur. Slab exhibits large enough crack widths to allow epoxy injection.

										
B1049_042a-DS1-1.JPG	B1049_042a-DS2-1.JPG									

Remove furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary) 5 feet either side of damaged area. Replace and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plumbing systems (as necessary).

Shore damaged area in the two stories below. Remove 100 square feet of concrete slab per column, preserving the slab reinforcement; lap splice 30 new 10 foot long rebar with existing rebar; place formwork; recast concrete slab; remove forms, replace and repair finishes; replace furnishings, ceilings, mechanical, electrical, and plumbing systems. Cracks wide enough to be grouted are included in the portion of slab to be demolished and recast.

FEMA P-58 Fragility Specification

NISTIR ClassificationB1051.001

NISTIR NameOrdinary reinforced masonry walls with partially grouted cells, shear dominated, 4" to 6" thick, up to 12 foot tall

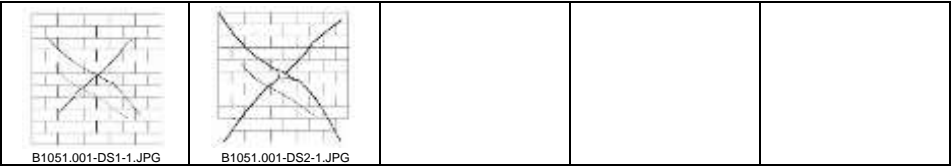
DescriptionCosting for each 100 ft^2 Wall Panel

Line 252

Construction Quality:	Not Specified					Quantity Rounding		Round Qty?	NO
Seismic Installation Conditions:	Not Specified					Allow sum by floor or building?		NO	
Fragility Unit of Measure:	SF 100					Demand Location (floor above?)		No	
Demand Parameter (unit):	Story Drift Ratio		Unit less						
Number of Damage States:	2								
Damage State:	DS1		DS2						
Type of Damage State:	Sequential		Sequential						
DS Hierarchy	Seq(DS1,DS2)								
Descriptions	First occurrence of major diagonal cracks. Cracks remain closed with hardly noticeable residual crack widths after load removal.		Wide diagonal cracks with typically one or more cracks in each direction. Crushing or spalling at wall toes.						

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.002	0.0033			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	0.86	0.77			
Total Dispersion, β :	0.86	0.77			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Grout wall. Epoxy injection. Paint each side. Shore. Demolish existing wall. Construct new wall.				

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.65E+03	4.20E+03	4.78E+03	4.65E+03	6.00E+03	6.75E+03									
Best fit mean:	4.21E+03			5.80E+03											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	2.00		30.00	2.00		30.00									
Average Repair Cost (Min Qty, Max Qty)	5.04E+03		3.36E+03	7.20E+03		4.80E+03									
CV or beta (Min Qty, Max Qty)	0.11		0.11	0.14		0.14									
Quantity Unit:	100 ft² Units			100 ft² Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.84E+00	3.27E+00	3.73E+00	3.62E+00	4.68E+00	5.26E+00									
Best fit mean:	3.27E+00			4.68E+00											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	2.00		30.00	2.00		30.00									
Average Repair Time (Min Qty, Max Qty)	3.92E+00		2.62E+00	5.62E+00		3.74E+00									
CV or beta (Min Qty, Max Qty)	0.27		0.27	0.29		0.29									
Quantity Unit:	100 ft² Units			100 ft² Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		25%	0.50										
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Benson Shing														
Revisions:	None														
Root Cost Multiplier: 100															

Root Cost Multiplier: 100

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1051.002

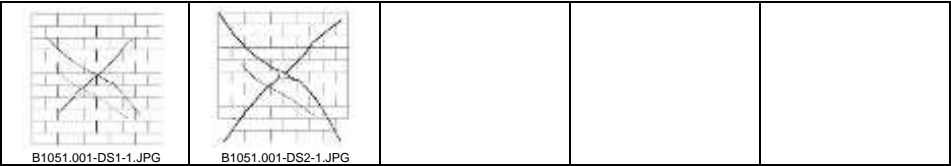
Ordinary reinforced masonry walls with partially grouted cells, shear dominated, 4" to 6" thick, greater than 12 foot tall
Costing for each 225 ft^2 Wall Panel

Line 253

Construction Quality:	Not Specified					<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	SF 225					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	First occurrence of major diagonal cracks. Cracks remain closed with hardly noticeable residual crack widths after load removal.		Wide diagonal cracks with typically one or more cracks in each direction. Crushing or spalling at wall toes.			

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Illustrations



Damage State Probability:	1.00		1.00		
Fragility Parameters					
Median Demand, θ :	0.002		0.0033		
Data dispersion, β_d :	Not Specified		Not Specified		
Uncertainty, β_u :	0.86		0.77		
Total Dispersion, β :	0.86		0.77		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Grout wall. Epoxy injection. Paint each side. Shore. Demolish existing wall. Construct new wall.				

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	7.38E+03	8.20E+03	9.08E+03	9.60E+03	1.24E+04	1.35E+04									
Best fit mean:	8.19E+03			1.18E+04											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	1.00		14.00	1.00		14.00									
Average Repair Cost (Min Qty, Max Qty)	9.84E+03		6.56E+03	1.49E+04		9.90E+03									
CV or beta (Min Qty, Max Qty)	0.08		0.08	0.13		0.13									
Quantity Unit:	225 ft² Units			225 ft² Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.30E+00	7.00E+00	7.74E+00	8.19E+00	1.06E+01	1.15E+01									
Best fit mean:	7.00E+00			1.06E+01											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	1.00		14.00	1.00		14.00									
Average Repair Time (Min Qty, Max Qty)	8.40E+00		5.60E+00	1.27E+01		8.44E+00									
CV or beta (Min Qty, Max Qty)	0.26		0.26	0.28		0.28									
Quantity Unit:	225 ft² Units			225 ft² Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		25%	0.50										
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Benson Shing														
Revisions:	None														
							Root Cost Multiplier: 225								

Root Cost Multiplier: 225

FEMA P-58 Fragility Specification

NISTIR ClassificationB1051.003


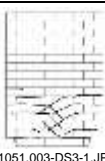
NISTIR NameOrdinary reinforced masonry walls with partially grouted cells, 4" to 6" thick, flexure dominated up to 12' tall

DescriptionCosting for each 100 ft*2 Wall Panel

Line 254

Construction Quality:	Not Specified				<div>Quantity Rounding</div> <div>Round Qty?</div> <div>NO</div> <div>Allow sum by floor or building?</div> <div>NO</div> <div>Demand Location (floor above?)</div> <div>No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	SF 100				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	A few flexural and shear cracks with hardly noticeable residual crack widths. Slight yielding of extreme vertical reinforcement. No spalling. No fracture or buckling of vertical reinforcement. No structurally significant damage.	Numerous flexural and diagonal cracks with residual crack widths less than 1/64 in. Mild toe crushing with vertical cracks or light spalling at wall toes. No fracture or buckling of reinforcement. Small residual deformation.	Severe flexural cracks with residual crack widths greater than 1/32 in. Severe toe crushing and spalling. Fracture or buckling of vertical reinforcement. Significant residual deformation.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	B1051.003-DS2-1.JPG	B1051.003-DS3-1.JPG		
Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ:	0.0018	0.0051	0.0086		
Data dispersion, β _d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β _u :	0.73	0.65	0.56		
Total Dispersion, β:	0.73	0.65	0.56		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Marginal				
Documentation Quality	Average				
Rationality	Superior				
Consequence Functions					
Repair Description	Cosmetic repair. Patch cracks and paint each side.	Remove loose masonry. Patch spalls with non-shrink grout. Grout wall. Epoxy injection. Paint each side.	Shore. - Demolish existing wall. - Construct new wall.		

Long Lead Time (Yes / No)				NO			NO			NO								
Repair Costs:				P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:				3.67E+02	6.00E+02	9.33E+02	3.65E+03	4.20E+03	4.78E+03	4.65E+03	6.00E+03	6.75E+03						
Best fit mean:				5.91E+02			4.21E+03			5.80E+03								
Best Fit Distribution:				LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)				2.00		30.00		2.00		30.00		2.00		30.00				
Average Repair Cost (Min Qty, Max Qty)				7.20E+02		4.80E+02		5.04E+03		3.36E+03		7.20E+03		4.80E+03				
CV or beta (Min Qty, Max Qty)				0.36		0.36		0.11		0.11		0.14		0.14				
Quantity Unit:				100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Repair Time:				P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:				2.90E-01	4.70E-01	7.30E-01	2.84E+00	3.27E+00	3.73E+00	3.62E+00	4.68E+00	5.26E+00						
Best fit mean:				4.70E-01			3.27E+00			4.68E+00								
Best Fit Distribution:				LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)				2.00		30.00		2.00		30.00		2.00		30.00				
Average Repair Time (Min Qty, Max Qty)				5.64E-01		3.76E-01		3.92E+00		2.62E+00		5.62E+00		3.74E+00				
CV or beta (Min Qty, Max Qty)				0.44		0.44		0.27		0.27		0.29		0.29				
Quantity Unit:				100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
LifeSafety Hazard:																		
Potential non-collapse casualties? (Yes / No)				NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:				Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)				0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)				0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:				NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)				0%	0.00		0%	0.00		25%	0.50							
Comments:				None														
Date Created:				Not Given														
Approved (YES / NO)?				By User														
Official (YES / NO) ?				By User														
Author:				Benson Shing														
Revisions:				None														
				Root Cost Multiplier: 100														

Root Cost Multiplier: 100

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1051.004

Ordinary reinforced masonry walls with partially grouted cells, 4" to 6" thick, flexure dominated greater than 12' tall
Costing for each 225 ft^2 Wall Panel

Line 255



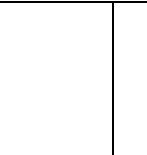
Construction Quality: Not Specified
Seismic Installation Conditions: Not Specified

Fragility Unit of Measure: SF 225
Demand Parameter (unit): Story Drift Ratio Unit less

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	A few flexural and shear cracks with hardly noticeable residual crack widths. Slight yielding of extreme vertical reinforcement. No spalling. No fracture or buckling of vertical reinforcement. No structurally significant damage.	Numerous flexural and diagonal cracks with residual crack widths less than 1/64 in. Mild toe crushing with vertical cracks or light spalling at wall toes. No fracture or buckling of reinforcement. Small residual deformation.	Severe flexural cracks with residual crack widths greater than 1/32 in. Severe toe crushing and spalling. Fracture or buckling of vertical reinforcement. Significant residual deformation.	

Illustrations

				
	none	B1051.003-DS2-1.JPG	B1051.003-DS3-1.JPG	
Damage State Probability:	1.00	1.00	1.00	

Fragility Parameters					
Median Demand, θ :	0.0018	0.0051	0.0086		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	0.73	0.65	0.56		
Total Dispersion, β :	0.73	0.65	0.56		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Marginal				
Documentation Quality	Average				
Rationality	Superior				
Consequence Functions					
Repair Description	Cosmetic repair. Patch cracks and paint each side.	Remove loose masonry. Patch spalls with non-shrink grout. Grout wall. Epoxy injection. Paint each side.	Shore. - Demolish existing wall. - Construct new wall.		

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Cost by Damage State:	8.25E+02	1.35E+03	2.10E+03	7.38E+03	8.20E+03	9.08E+03	9.60E+03	1.24E+04	1.35E+04						
Best fit mean:	1.33E+03			8.19E+03			1.18E+04								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	1.00	14.00		1.00	14.00		1.00	14.00							
Average Repair Cost (Min Qty, Max Qty)	1.62E+03	1.08E+03		9.84E+03	6.56E+03		1.49E+04	9.90E+03							
CV or beta (Min Qty, Max Qty)	0.36	0.36		0.08	0.08		0.13	0.13							
Quantity Unit:	225 ft^2 Units			225 ft^2 Units			225 ft^2 Units								
Repair Time:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Time by Damage State:	6.98E-01	1.15E+00	1.80E+00	6.30E+00	7.00E+00	7.74E+00	8.19E+00	1.06E+01	1.15E+01						
Best fit mean:	1.15E+00			7.00E+00			1.06E+01								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	1.00	14.00		1.00	14.00		1.00	14.00							
Average Repair Time (Min Qty, Max Qty)	1.38E+00	9.17E-01		8.40E+00	5.60E+00		1.27E+01	8.44E+00							
CV or beta (Min Qty, Max Qty)	0.44	0.44		0.26	0.26		0.28	0.28							
Quantity Unit:	225 ft^2 Units			225 ft^2 Units			225 ft^2 Units								
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		25%	0.50							
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Benson Shing														
Revisions:	None														

Root Cost Multiplier: 225

FEMA P-58 Fragility Specification

NISTIR ClassificationB1051.011

NISTIR NameOrdinary reinforced masonry walls with partially grouted cells, shear dominated, 8" to 12" thick, up to 12 foot tall

DescriptionCosting for each 100 ft^2 Wall Panel

Line 256

Construction Quality:		Not Specified			<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:		Not Specified			
Fragility Unit of Measure:		SF 100			
Demand Parameter (unit):		Story Drift Ratio	Unit less		
Number of Damage States:		2			
Damage State:		DS1	DS2		
Type of Damage State:		Sequential		Sequential	
DS Hierarchy		Seq(DS1,DS2)			
Descriptions		First occurrence of major diagonal cracks. Cracks remain closed with hardly noticeable residual crack widths after load removal.		Wide diagonal cracks with typically one or more cracks in each direction. Crushing or spalling at wall toes.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Illustrations



Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.002	0.0033			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	0.86	0.77			
Total Dispersion, β :	0.86	0.77			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Marginal				
Documentation Quality	Average				
Rationality	Superior				
Consequence Functions					
Repair Description	Grout wall. Epoxy injection. Paint each side. Shore. Demolish existing wall. Construct new wall.				

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.80E+03	4.35E+03	4.93E+03	5.78E+03	7.63E+03	8.38E+03									
Best fit mean:	4.36E+03			7.27E+03											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	2.00		30.00	2.00		30.00									
Average Repair Cost (Min Qty, Max Qty)	5.22E+03		3.48E+03	9.16E+03		6.11E+03									
CV or beta (Min Qty, Max Qty)	0.10		0.10	0.14		0.14									
Quantity Unit:	100 ft² Units			100 ft² Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.96E+00	3.39E+00	3.85E+00	4.51E+00	5.95E+00	6.53E+00									
Best fit mean:	3.39E+00			5.95E+00											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	2.00		30.00	2.00		30.00									
Average Repair Time (Min Qty, Max Qty)	4.07E+00		2.71E+00	7.14E+00		4.76E+00									
CV or beta (Min Qty, Max Qty)	0.27		0.27	0.29		0.29									
Quantity Unit:	100 ft² Units			100 ft² Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		25%	0.50										
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Benson Shing														
Revisions:	None														
Root Cost Multiplier: 100															

Root Cost Multiplier: 100

Line 257

Ordinary reinforced masonry walls with partially grouted cells, shear dominated, 8" to 12" thick, greater than 12 foot tall
Costing for each 225 ft² Wall Panel

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Demand Parameter (Unit):	Start Shift Ratio:	Shift Loss:	Demand Location (refer above) / No		
Number of Damage States:	2				
Damage State:	DS1	DS2			

DS Hierarchy Descriptions

Illustrations



Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.002	0.0033			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	0.86	0.77			
Total Dispersion, β:	0.86	0.77			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Marginal				
Documentation Quality	Average				
Rationality	Superior				
Consequence Functions					
Repair Description	Grout wall. Epoxy injection. Paint each side.	Shore. Demolish existing wall. Construct new wall.			

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	7.71E+03	8.54E+03	9.41E+03	1.19E+04	1.58E+04	1.67E+04						
Best fit mean:	8.53E+03			1.48E+04								
Best Fit Distribution:	LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	1.00	14.00		1.00	14.00							
Average Repair Cost (Min Qty, Max Qty)	1.02E+04	6.83E+03		1.90E+04	1.26E+04							
CV or beta (Min Qty, Max Qty)	0.08	0.08		0.13	0.13							
Quantity Unit:	225 ft² Units			225 ft² Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.57E+00	7.29E+00	8.03E+00	1.01E+01	1.35E+01	1.42E+01						
Best fit mean:	7.29E+00			1.35E+01								
Best Fit Distribution:	LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	1.00	14.00		1.00	14.00							
Average Repair Time (Min Qty, Max Qty)	8.75E+00	5.83E+00		1.62E+01	1.08E+01							
CV or beta (Min Qty, Max Qty)	0.26	0.26		0.28	0.28							
Quantity Unit:	225 ft² Units			225 ft² Units								
Life/Safety Hazard:												
Potential non-collapse casualties? (Yes / No)	NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		25%	0.50							

Dispersions:	0%
Comments:	None
Date Created:	Not Given
Approved (YES / NO)?	By User
Official (YES / NO) ?	By User
Author:	Benson Shing
Revisions:	None

Root Cost Multiplier: 225

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1051.013



Ordinary reinforced masonry walls with partially grouted cells, 8" to 12" thick, flexure dominated up to 12' tall

Costing for each 100 ft*2 Wall Panel,

Line 258

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above)?No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	SF 100				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	A few flexural and shear cracks with hardly noticeable residual crack widths. Slight yielding of extreme vertical reinforcement. No spalling. No fracture or buckling of vertical reinforcement. No structurally significant damage.	Numerous flexural and diagonal cracks with residual crack widths less than 1/64 in. Mild toe crushing with vertical cracks or light spalling at wall toes. No fracture or buckling of reinforcement. Small residual deformation.	Severe flexural cracks with residual crack widths greater than 1/32 in. Severe toe crushing and spalling. Fracture or buckling of vertical reinforcement. Significant residual deformation.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	B1051.003-DS2-1.JPG	B1051.003-DS3-1.JPG		
Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0018	0.0051	0.0086		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	0.73	0.65	0.56		
Total Dispersion, β :	0.73	0.65	0.56		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Marginal				
Documentation Quality	Average				
Rationality	Superior				
Consequence Functions					
Repair Description	Cosmetic repair. Patch cracks and paint each side.	Remove loose masonry. Patch spalls with non-shrink grout. Grout wall. Epoxy injection. Paint each side.	Shore. - Demolish existing wall. - Construct new wall.		

Long Lead Time (Yes / No)				NO			NO			NO								
Repair Costs:				P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:				3.67E+02	6.00E+02	9.33E+02	3.80E+03	4.35E+03	4.93E+03	5.78E+03	7.63E+03	8.38E+03						
Best fit mean:				5.91E+02			4.36E+03			7.27E+03								
Best Fit Distribution:				LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)				2.00		30.00	2.00		30.00	2.00		30.00						
Average Repair Cost (Min Qty, Max Qty)				7.20E+02		4.80E+02	5.22E+03		3.48E+03	9.16E+03		6.11E+03						
CV or beta (Min Qty, Max Qty)				0.36		0.36	0.10		0.10	0.14		0.14						
Quantity Unit:				100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Repair Time:				P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:				2.90E-01	4.70E-01	7.30E-01	2.96E+00	3.39E+00	3.85E+00	4.51E+00	5.95E+00	6.53E+00						
Best fit mean:				4.70E-01			3.39E+00			5.95E+00								
Best Fit Distribution:				LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)				2.00		30.00	2.00		30.00	2.00		30.00						
Average Repair Time (Min Qty, Max Qty)				5.64E-01		3.76E-01	4.07E+00		2.71E+00	7.14E+00		4.76E+00						
CV or beta (Min Qty, Max Qty)				0.44		0.44	0.27		0.27	0.29		0.29						
Quantity Unit:				100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
LifeSafety Hazard:																		
Potential non-collapse casualties? (Yes / No)				NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:				Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)				0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)				0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:				NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)				0%	0.00		0%	0.00		25%	0.50							
Comments:				None														
Date Created:				Not Given														
Approved (YES / NO)?				By User														
Official (YES / NO) ?				By User														
Author:				Benson Shing														
Revisions:				None														
				Root Cost Multiplier: 100														

Root Cost Multiplier: 100

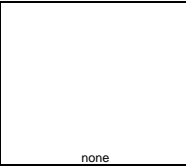
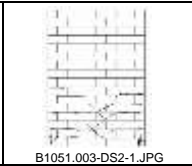
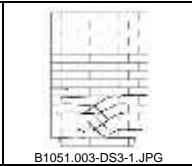
FEMA P-58 Fragility Specification

NISTIR Classification B1051.014
NISTIR Name Ordinary reinforced masonry walls with partially grouted cells, 8" to 12" thick, flexure dominated greater than 12' tall
Description Costing for each 225 ft^2 Wall Panel

Line 259

Construction Quality:	Not Specified			<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above)?No</div>
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	SF 225			
Demand Parameter (unit):	Story Drift Ratio	Unit less		
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	A few flexural and shear cracks with hardly noticeable residual crack widths. Slight yielding of extreme vertical reinforcement. No spalling. No fracture or buckling of vertical reinforcement. No structurally significant damage.	Numerous flexural and diagonal cracks with residual crack widths less than 1/64 in. Mild toe crushing with vertical cracks or light spalling at wall toes. No fracture or buckling of reinforcement. Small residual deformation.	Severe flexural cracks with residual crack widths greater than 1/32 in. Severe toe crushing and spalling. Fracture or buckling of vertical reinforcement. Significant residual deformation.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	B1051.003-DS2-1.JPG	B1051.003-DS3-1.JPG		
Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0018	0.0051	0.0086		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	0.73	0.65	0.56		
Total Dispersion, β :	0.73	0.65	0.56		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings	Not Rated				
Data Quality	Marginal				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality					
Consequence Functions					
Repair Description	Cosmetic repair. Patch cracks and paint each side.	Remove loose masonry. Patch spalls with non-shrink grout. Grout wall. Epoxy injection. Paint each side.	Shore. - Demolish existing wall. - Construct new wall.		

Long Lead Time (Yes / No)				NO			NO			NO								
Repair Costs:				P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Cost by Damage State:				8.25E+02	1.35E+03	2.10E+03	7.71E+03	8.54E+03	9.41E+03	1.19E+04	1.58E+04	1.67E+04						
Best fit mean:				1.33E+03			8.53E+03			1.48E+04								
Best Fit Distribution:				LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)				1.00	14.00		1.00	14.00		1.00	14.00							
Average Repair Cost (Min Qty, Max Qty)				1.62E+03	1.08E+03		1.02E+04	6.83E+03		1.90E+04	1.26E+04							
CV or beta (Min Qty, Max Qty)				0.36	0.36		0.08	0.08		0.13	0.13							
Quantity Unit:				225 ft^2 Units			225 ft^2 Units			225 ft^2 Units								
Repair Time:				P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Time by Damage State:				6.98E-01	1.15E+00	1.80E+00	6.57E+00	7.29E+00	8.03E+00	1.01E+01	1.35E+01	1.42E+01						
Best fit mean:				1.15E+00			7.29E+00			1.35E+01								
Best Fit Distribution:				LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)				1.00	14.00		1.00	14.00		1.00	14.00							
Average Repair Time (Min Qty, Max Qty)				1.38E+00	9.17E-01		8.75E+00	5.83E+00		1.62E+01	1.08E+01							
CV or beta (Min Qty, Max Qty)				0.44	0.44		0.26	0.26		0.28	0.28							
Quantity Unit:				225 ft^2 Units			225 ft^2 Units			225 ft^2 Units								
LifeSafety Hazard:																		
Potential non-collapse casualties? (Yes / No)				NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:				Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)				0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)				0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:				NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)				0%	0.00		0%	0.00		25%	0.50							
Comments:				None														
Date Created:				Not Given														
Approved (YES / NO)?				By User														
Official (YES / NO) ?				By User														
Author:				Benson Shing														
Revisions:				None														
				Root Cost Multiplier: 225														

Root Cost Multiplier: 225

FEMA P-58 Fragility Specification

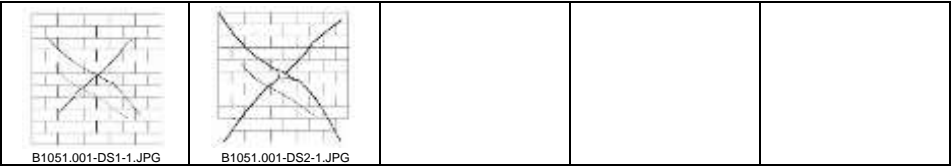
NISTIR Classification B1051.021
NISTIR Name Ordinary reinforced masonry walls with partially grouted cells, shear dominated, 16" thick, up to 12 foot tall
Description Costing for each 100 ft*2 Wall Panel

Line 260

Construction Quality:		Not Specified		<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>	
Seismic Installation Conditions:		Not Specified			
Fragility Unit of Measure:		SF 100			
Demand Parameter (unit):		Story Drift RatioUnit less			
Number of Damage States:		2			
Damage State:		DS1DS2			
Type of Damage State:		SequentialSequential			
DS Hierarchy		Seq(DS1,DS2)			
Descriptions		First occurrence of major diagonal cracks. Cracks remain closed with hardly noticeable residual crack widths after load removal.		Wide diagonal cracks with typically one or more cracks in each direction. Crushing or spalling at wall toes.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.002	0.0033			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	0.86	0.77			
Total Dispersion, β :	0.86	0.77			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Marginal				
Documentation Quality	Average				
Rationality	Superior				
Consequence Functions					
Repair Description	Grout wall. Epoxy injection. Paint each side. Shore. Demolish existing wall. Construct new wall.				

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.95E+03	4.50E+03	5.08E+03	6.62E+03	8.47E+03	9.22E+03									
Best fit mean:	4.51E+03			8.10E+03											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	2.00		30.00	2.00		30.00									
Average Repair Cost (Min Qty, Max Qty)	5.85E+03		3.15E+03	1.02E+04		6.35E+03									
CV or beta (Min Qty, Max Qty)	0.10		0.10	0.13		0.13									
Quantity Unit:	100 ft*2 Units			100 ft*2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.08E+00	3.51E+00	3.96E+00	5.16E+00	6.60E+00	7.18E+00									
Best fit mean:	3.51E+00			6.60E+00											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	2.00		30.00	2.00		30.00									
Average Repair Time (Min Qty, Max Qty)	4.56E+00		2.46E+00	7.92E+00		4.95E+00									
CV or beta (Min Qty, Max Qty)	0.27		0.27	0.28		0.28									
Quantity Unit:	100 ft*2 Units			100 ft*2 Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		25%	0.50										
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Benson Shing														
Revisions:	None														
	Root Cost Multiplier: 100														

Root Cost Multiplier: 100

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1051.022

Ordinary reinforced masonry walls with partially grouted cells, shear dominated,16" thick, greater than 12 foot tall
Costing for each 225 ft^2 Wall Panel

Line 261

Construction Quality: Not Specified
Seismic Installation Conditions: Not Specified

Fragility Unit of Measure: SF 225
Demand Parameter (unit): Story Drift Ratio Unit less

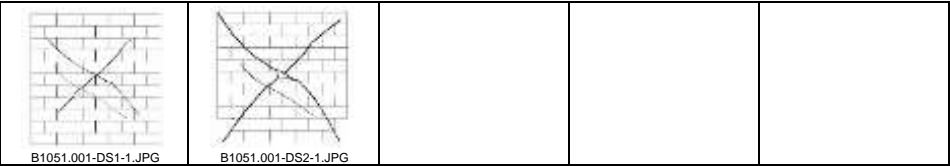
Number of Damage States: 2
Damage State: DS1 DS2

Type of Damage State: Sequential Sequential
DS Hierarchy Seq(DS1,DS2)

Descriptions First occurrence of major diagonal cracks. Cracks remain closed with hardly noticeable residual crack widths after load removal. Wide diagonal cracks with typically one or more cracks in each direction. Crushing or spalling at wall toes.

Quantity Rounding Round Qty? NO
Allow sum by floor or building? NO
Demand Location (floor above?) No

Illustrations



Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.002	0.0033			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	0.86	0.77			
Total Dispersion, β :	0.86	0.77			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Marginal				
Documentation Quality	Average				
Rationality	Superior				
Consequence Functions					
Repair Description	Grout wall. Epoxy injection. Paint each side.	Shore. Demolish existing wall. Construct new wall.			

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	7.80E+03	8.63E+03	9.50E+03	1.35E+04	1.74E+04	1.83E+04									
Best fit mean:	8.61E+03			1.64E+04											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	1.00		14.00	1.00		14.00									
Average Repair Cost (Min Qty, Max Qty)	1.12E+04		6.04E+03	2.09E+04		1.31E+04									
CV or beta (Min Qty, Max Qty)	0.08		0.08	0.11		0.11									
Quantity Unit:	225 ft^2 Units			225 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.66E+00	7.36E+00	8.10E+00	1.15E+01	1.49E+01	1.56E+01									
Best fit mean:	7.36E+00			1.49E+01											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	1.00		14.00	1.00		14.00									
Average Repair Time (Min Qty, Max Qty)	9.56E+00		5.15E+00	1.78E+01		1.12E+01									
CV or beta (Min Qty, Max Qty)	0.26		0.26	0.27		0.27									
Quantity Unit:	225 ft^2 Units			225 ft^2 Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		25%	0.50										
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Benson Shing														
Revisions:	None														

Root Cost Multiplier: 225


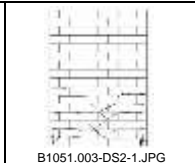
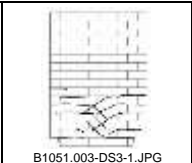
FEMA P-58 Fragility Specification

NISTIR Classification B1051.023
NISTIR Name Ordinary reinforced masonry walls with partially grouted cells, 16" thick, flexure dominated up to 12' tall
Description Costing for each 100 ft*2 Wall Panel

Line 262

Construction Quality:	Not Specified			<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above)?No</div>
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	SF 100			
Demand Parameter (unit):	Story Drift Ratio	Unit less		
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	A few flexural and shear cracks with hardly noticeable residual crack widths. Slight yielding of extreme vertical reinforcement. No spalling. No fracture or buckling of vertical reinforcement. No structurally significant damage.	Numerous flexural and diagonal cracks with residual crack widths less than 1/64 in. Mild toe crushing with vertical cracks or light spalling at wall toes. No fracture or buckling of reinforcement. Small residual deformation.	Severe flexural cracks with residual crack widths greater than 1/32 in. Severe toe crushing and spalling. Fracture or buckling of vertical reinforcement. Significant residual deformation.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations				
				
	none	B1051.003-DS2-1.JPG	B1051.003-DS3-1.JPG	
Damage State Probability:	1.00	1.00	1.00	
Fragility Parameters				
Median Demand, θ :	0.0018	0.0051	0.0086	
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified	
Uncertainty, β_u :	0.73	0.65	0.56	
Total Dispersion, β :	0.73	0.65	0.56	
Correlation (Yes / No)	NO			
Directionality (Yes / No)	YES			
Quality Ratings	Not Rated			
Data Quality	Marginal			
Data Relevance	Average			
Documentation Quality	Superior			
Rationality				
Consequence Functions				
Repair Description	Cosmetic repair. Patch cracks and paint each side.	Remove loose masonry. Patch spalls with non-shrink grout. Grout wall. Epoxy injection. Paint each side.	Shore. - Demolish existing wall. - Construct new wall.	

Long Lead Time (Yes / No)				NO			NO			NO								
Repair Costs:				P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:				3.67E+02	6.00E+02	9.33E+02	3.95E+03	4.50E+03	5.08E+03	6.62E+03	8.47E+03	9.22E+03						
Best fit mean:				5.91E+02			4.51E+03			8.10E+03								
Best Fit Distribution:				LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)				2.00	30.00		2.00	30.00		2.00	30.00							
Average Repair Cost (Min Qty, Max Qty)				7.80E+02	4.20E+02		5.40E+03	3.38E+03		1.02E+04	6.35E+03							
CV or beta (Min Qty, Max Qty)				0.36	0.36		0.10	0.10		0.13	0.13							
Quantity Unit:				100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Repair Time:				P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:				2.90E-01	4.70E-01	7.30E-01	3.08E+00	3.51E+00	3.96E+00	5.16E+00	6.60E+00	7.18E+00						
Best fit mean:				4.70E-01			3.51E+00			6.60E+00								
Best Fit Distribution:				LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)				2.00	30.00		2.00	30.00		2.00	30.00							
Average Repair Time (Min Qty, Max Qty)				6.10E-01	3.30E-01		4.21E+00	2.63E+00		7.92E+00	4.95E+00							
CV or beta (Min Qty, Max Qty)				0.44	0.44		0.27	0.27		0.28	0.28							
Quantity Unit:				100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
LifeSafety Hazard:				NO			NO			NO								
Potential non-collapse casualties? (Yes / No)				NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:				Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)				0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)				0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:				NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)				0%	0.00		0%	0.00		25%	0.50							
Comments:				None														
Date Created:				Not Given														
Approved (YES / NO)?				By User														
Official (YES / NO) ?				By User														
Author:				Benson Shing														
Revisions:				None														
				Root Cost Multiplier: 100														

Root Cost Multiplier: 100


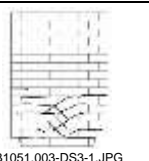
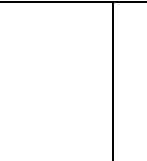
FEMA P-58 Fragility Specification

NISTIR Classification B1051.024
NISTIR Name Ordinary reinforced masonry walls with partially grouted cells, 16" thick, flexure dominated greater than 12' tall
Description Costing for each 225 ft^2 Wall Panel

Line 263

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above)?No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	SF 225				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	A few flexural and shear cracks with hardly noticeable residual crack widths. Slight yielding of extreme vertical reinforcement. No spalling. No fracture or buckling of vertical reinforcement. No structurally significant damage.	Numerous flexural and diagonal cracks with residual crack widths less than 1/64 in. Mild toe crushing with vertical cracks or light spalling at wall toes. No fracture or buckling of reinforcement. Small residual deformation.	Severe flexural cracks with residual crack widths greater than 1/32 in. Severe toe crushing and spalling. Fracture or buckling of vertical reinforcement. Significant residual deformation.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Illustrations					
	none	B1051.003-DS2-1.JPG	B1051.003-DS3-1.JPG		
Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0018	0.0051	0.0086		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	0.73	0.65	0.56		
Total Dispersion, β :	0.73	0.65	0.56		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings	Not Rated				
Data Quality	Marginal				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality					
Consequence Functions					
Repair Description	Cosmetic repair. Patch cracks and paint each side.	Remove loose masonry. Patch spalls with non-shrink grout. Grout wall. Epoxy injection. Paint each side.	Shore. - Demolish existing wall. - Construct new wall.		

Long Lead Time (Yes / No)				NO			NO			NO								
Repair Costs:				P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Cost by Damage State:				8.25E+02	1.35E+03	2.10E+03	7.80E+03	8.63E+03	9.50E+03	1.35E+04	1.74E+04	1.83E+04						
Best fit mean:				1.33E+03			8.61E+03			1.64E+04								
Best Fit Distribution:				LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)				1.00	14.00		1.00	14.00		1.00	14.00							
Average Repair Cost (Min Qty, Max Qty)				1.76E+03	9.45E+02		1.04E+04	6.47E+03		2.09E+04	1.31E+04							
CV or beta (Min Qty, Max Qty)				0.36	0.36		0.08	0.08		0.11	0.11							
Quantity Unit:				225 ft^2 Units			225 ft^2 Units			225 ft^2 Units								
Repair Time:				P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Time by Damage State:				6.98E-01	1.15E+00	1.80E+00	6.66E+00	7.36E+00	8.10E+00	1.15E+01	1.49E+01	1.56E+01						
Best fit mean:				1.15E+00			7.36E+00			1.49E+01								
Best Fit Distribution:				LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)				1.00	14.00		1.00	14.00		1.00	14.00							
Average Repair Time (Min Qty, Max Qty)				1.49E+00	8.02E-01		8.83E+00	5.52E+00		1.78E+01	1.12E+01							
CV or beta (Min Qty, Max Qty)				0.44	0.44		0.26	0.26		0.27	0.27							
Quantity Unit:				225 ft^2 Units			225 ft^2 Units			225 ft^2 Units								
LifeSafety Hazard:																		
Potential non-collapse casualties? (Yes / No)				NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:				Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)				0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)				0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:				NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)				0%	0.00		0%	0.00		25%	0.50							
Comments:				None														
Date Created:				Not Given														
Approved (YES / NO)?				By User														
Official (YES / NO) ?				By User														
Author:				Benson Shing														
Revisions:				None														
Root Cost Multiplier: 225																		

Root Cost Multiplier: 225

FEMA P-58 Fragility Specification

NISTIR ClassificationB1052.001

NISTIR NameDescription

Special reinforced masonry walls with fully grouted cells, 8" or 12" thick, shear dominated, up to 12' tall

Costing for each 100 ft^2 Wall Panel

Line 264

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	SF 100				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	2				
Damage State:	DS1		DS2		
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	First occurrence of major diagonal cracks. Cracks remain closed with hardly noticeable residual crack widths after load removal.		Wide diagonal cracks with typically one or more cracks in each direction. Crushing or spalling at wall toes.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00		1.00		
Fragility Parameters					
Median Demand, θ :	0.0036		0.0059		
Data dispersion, β_d :	0.54		0.44		
Uncertainty, β_u :	0.24		0.26		
Total Dispersion, β :	0.59		0.51		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Marginal				
Documentation Quality	Average				
Rationality	Superior				
Consequence Functions					
Repair Description	Epoxy injection. Paint each side.		Shore. Demolish existing wall. Construct new wall.		

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.40E+03	3.95E+03	4.53E+03	5.98E+03	7.83E+03	8.42E+03									
Best fit mean:	3.96E+03			7.41E+03											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	2.00		30.00	2.00		30.00									
Average Repair Cost (Min Qty, Max Qty)	5.14E+03		2.77E+03	9.40E+03		5.88E+03									
CV or beta (Min Qty, Max Qty)	0.11		0.11	0.13		0.13									
Quantity Unit:	100 ft² Units			100 ft² Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.65E+00	3.08E+00	3.53E+00	4.66E+00	6.11E+00	6.56E+00									
Best fit mean:	3.08E+00			6.11E+00											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	2.00		30.00	2.00		30.00									
Average Repair Time (Min Qty, Max Qty)	4.00E+00		2.16E+00	7.33E+00		4.58E+00									
CV or beta (Min Qty, Max Qty)	0.27		0.27	0.28		0.28									
Quantity Unit:	100 ft² Units			100 ft² Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		25%	0.50										
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Benson Shing														
Revisions:	None														
Root Cost Multiplier: 100															

Root Cost Multiplier: 100

FEMA P-58 Fragility Specification

NISTIR ClassificationB1052.002

NISTIR NameDescription

Special reinforced masonry walls with fully grouted cells, 8" or 12" thick, shear dominated, greater than 12" tall

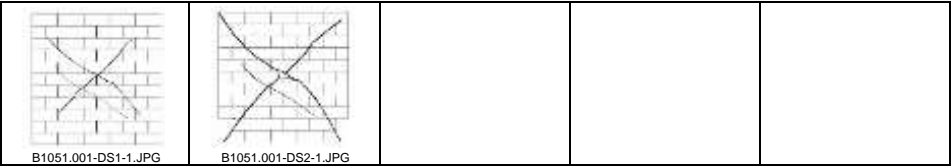
Costing for each 225 ft^2 Wall Panel

Line 265

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	SF 225				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	2				
Damage State:	DS1		DS2		
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	First occurrence of major diagonal cracks. Cracks remain closed with hardly noticeable residual crack widths after load removal.		Wide diagonal cracks with typically one or more cracks in each direction. Crushing or spalling at wall toes.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00		1.00		
Fragility Parameters					
Median Demand, θ :	0.0036		0.0059		
Data dispersion, β_d :	0.54		0.44		
Uncertainty, β_u :	0.24		0.26		
Total Dispersion, β :	0.59		0.51		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Marginal				
Documentation Quality	Average				
Rationality	Superior				
Consequence Functions					
Repair Description	Epoxy injection. Paint each side.		Shore. Demolish existing wall. Construct new wall.		

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	6.81E+03	7.64E+03	8.51E+03	1.24E+04	1.63E+04	1.71E+04									
Best fit mean:	7.62E+03			1.52E+04											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	1.00	14.00		1.00	14.00										
Average Repair Cost (Min Qty, Max Qty)	9.93E+03	5.35E+03		1.95E+04	1.22E+04										
CV or beta (Min Qty, Max Qty)	0.09	0.09		0.12	0.12										
Quantity Unit:	225 ft² Units			225 ft² Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.81E+00	6.53E+00	7.27E+00	1.05E+01	1.39E+01	1.46E+01									
Best fit mean:	6.53E+00			1.39E+01											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	1.00	14.00		1.00	14.00										
Average Repair Time (Min Qty, Max Qty)	8.48E+00	4.57E+00		1.66E+01	1.04E+01										
CV or beta (Min Qty, Max Qty)	0.26	0.26		0.28	0.28										
Quantity Unit:	225 ft² Units			225 ft² Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		25%	0.50										
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Benson Shing														
Revisions:	None														
Root Cost Multiplier: 225															

Root Cost Multiplier: 225


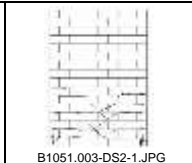
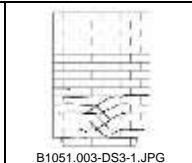
FEMA P-58 Fragility Specification

NISTIR Classification B1052.003
NISTIR Name Special reinforced masonry walls with fully grouted cells, 8" to 12" thick, flexure dominated up to 12' tall
Description Costing for each 100 ft*2 Wall Panel

Line 266

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above)?No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	SF 100				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	A few flexural and shear cracks with hardly noticeable residual crack widths. Slight yielding of extreme vertical reinforcement. No spalling. No fracture or buckling of vertical reinforcement. No structurally significant damage.	Numerous flexural and diagonal cracks with residual crack widths less than 1/64 in. Mild toe crushing with vertical cracks or light spalling at wall toes. No fracture or buckling of reinforcement. Small residual deformation.	Severe flexural cracks with residual crack widths greater than 1/32 in. Severe toe crushing and spalling. Fracture or buckling of vertical reinforcement. Significant residual deformation.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Illustrations				
				
	none	B1051.003-DS2-1.JPG	B1051.003-DS3-1.JPG	
Damage State Probability:	1.00	1.00	1.00	
Fragility Parameters				
Median Demand, θ :	0.0031	0.009	0.0151	
Data dispersion, β_d :	0.4	0.27	0.2	
Uncertainty, β_u :	0.25	0.25	0.25	
Total Dispersion, β :	0.47	0.4	0.32	
Correlation (Yes / No)	NO			
Directionality (Yes / No)	YES			
Quality Ratings				
Data Quality	Not Rated			
Data Relevance	Marginal			
Documentation Quality	Average			
Rationality	Superior			
Consequence Functions				
Repair Description	Cosmetic repair. Patch cracks and paint each side.	Epoxy injection to repair cracks. Remove loose masonry. Patch spalls with non-shrink grout. Paint each side.	Shore. - Demolish existing wall. - Construct new wall.	

Long Lead Time (Yes / No)				NO			NO			NO								
Repair Costs:				P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:				3.67E+02	6.00E+02	9.33E+02	3.40E+03	3.95E+03	4.53E+03	5.98E+03	7.83E+03	8.42E+03						
Best fit mean:				5.91E+02			3.98E+03			7.41E+03								
Best Fit Distribution:				LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)				2.00	30.00		2.00	30.00		2.00	30.00							
Average Repair Cost (Min Qty, Max Qty)				9.00E+02	4.80E+02		5.93E+03	3.36E+03		1.18E+04	6.66E+03							
CV or beta (Min Qty, Max Qty)				0.36	0.36		0.11	0.11		0.13	0.13							
Quantity Unit:				100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Repair Time:				P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:				2.90E-01	4.70E-01	7.30E-01	2.65E+00	3.08E+00	3.53E+00	4.66E+00	6.11E+00	6.56E+00						
Best fit mean:				4.70E-01			3.08E+00			6.11E+00								
Best Fit Distribution:				LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)				2.00	30.00		2.00	30.00		2.00	30.00							
Average Repair Time (Min Qty, Max Qty)				7.04E-01	3.76E-01		4.62E+00	2.62E+00		9.16E+00	5.19E+00							
CV or beta (Min Qty, Max Qty)				0.44	0.44		0.27	0.27		0.28	0.28							
Quantity Unit:				100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
LifeSafety Hazard:																		
Potential non-collapse casualties? (Yes / No)				NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:				Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)				0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)				0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:				NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)				0%	0.00		0%	0.00		25%	0.50							
Comments:				None														
Date Created:				Not Given														
Approved (YES / NO)?				By User														
Official (YES / NO) ?				By User														
Author:				Benson Shing														
Revisions:				None														
				Root Cost Multiplier: 100														

Root Cost Multiplier: 100

FEMA P-58 Fragility Specification

NISTIR Classification B1052.004
NISTIR Name Special reinforced masonry walls with fully grouted cells, 8" to 12" thick, flexure dominated greater than 12' tall
Description Costing for each 225 ft*2 Wall Panel

Line 267

Construction Quality:	Not Specified			<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above)?No</div>
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	SF 225			
Demand Parameter (unit):	Story Drift Ratio	Unit less		
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	A few flexural and shear cracks with hardly noticeable residual crack widths. Slight yielding of extreme vertical reinforcement. No spalling. No fracture or buckling of vertical reinforcement. No structurally significant damage.	Numerous flexural and diagonal cracks with residual crack widths less than 1/64 in. Mild toe crushing with vertical cracks or light spalling at wall toes. No fracture or buckling of reinforcement. Small residual deformation.	Severe flexural cracks with residual crack widths greater than 1/32 in. Severe toe crushing and spalling. Fracture or buckling of vertical reinforcement. Significant residual deformation.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Illustrations					
	none	B1051.003-DS2-1.JPG	B1051.003-DS3-1.JPG		
Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0031	0.009	0.0151		
Data dispersion, β_d :	0.4	0.27	0.2		
Uncertainty, β_u :	0.25	0.25	0.25		
Total Dispersion, β :	0.47	0.4	0.32		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings	Not Rated				
Data Quality	Marginal				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality					
Consequence Functions					
Repair Description	Cosmetic repair. Patch cracks and paint each side.	Epoxy injection to repair cracks. Remove loose masonry. Patch spalls with non-shrink grout. Paint each side.	Shore. - Demolish existing wall. - Construct new wall.		

Long Lead Time (Yes / No)				NO			NO			NO								
Repair Costs:				P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Cost by Damage State:				8.25E+02	1.35E+03	2.10E+03	6.81E+03	7.64E+03	8.51E+03	1.24E+04	1.63E+04	1.71E+04						
Best fit mean:				1.33E+03			7.62E+03			1.52E+04								
Best Fit Distribution:				LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)				1.00		14.00	1.00		14.00	1.00		14.00						
Average Repair Cost (Min Qty, Max Qty)				2.03E+03		1.08E+03	1.15E+04		6.49E+03	2.44E+04		1.38E+04						
CV or beta (Min Qty, Max Qty)				0.36		0.36	0.09		0.09	0.12		0.12						
Quantity Unit:				225 ft*2 Units			225 ft*2 Units			225 ft*2 Units								
Repair Time:				P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Time by Damage State:				6.98E-01	1.15E+00	1.80E+00	5.81E+00	6.53E+00	7.27E+00	1.05E+01	1.39E+01	1.46E+01						
Best fit mean:				1.15E+00			6.53E+00			1.39E+01								
Best Fit Distribution:				LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)				1.00		14.00	1.00		14.00	1.00		14.00						
Average Repair Time (Min Qty, Max Qty)				1.72E+00		9.17E-01	9.78E+00		5.55E+00	2.08E+01		1.18E+01						
CV or beta (Min Qty, Max Qty)				0.44		0.44	0.26		0.26	0.28		0.28						
Quantity Unit:				225 ft*2 Units			225 ft*2 Units			225 ft*2 Units								
LifeSafety Hazard:																		
Potential non-collapse casualties? (Yes / No)				NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:				Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)				0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)				0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:				NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)				0%	0.00		0%	0.00		25%	0.50							
Comments:				None														
Date Created:				Not Given														
Approved (YES / NO)?				By User														
Official (YES / NO) ?				By User														
Author:				Benson Shing														
Revisions:				None														
				Root Cost Multiplier: 225														

Root Cost Multiplier: 225

FEMA P-58 Fragility Specification

NISTIR Classification B1052.011
NISTIR Name Special reinforced masonry walls with fully grouted cells, 16" thick, shear dominated, up to 12' tall
Description Costing for each 100 ft^2 Wall Panel

Line 268

Construction Quality:		Not Specified		<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>	
Seismic Installation Conditions:		Not Specified			
Fragility Unit of Measure:		SF 100			
Demand Parameter (unit):		Story Drift RatioUnit less			
Number of Damage States:		2			
Damage State:		DS1		DS2	
Type of Damage State:		Sequential		Sequential	
DS Hierarchy		Seq(DS1,DS2)			
Descriptions		First occurrence of major diagonal cracks. Cracks remain closed with hardly noticeable residual crack widths after load removal.		Wide diagonal cracks with typically one or more cracks in each direction. Crushing or spalling at wall toes.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations



Damage State Probability:	1.00		1.00		
Fragility Parameters					
Median Demand, θ :	0.0036		0.0059		
Data dispersion, β_d :	0.54		0.44		
Uncertainty, β_u :	0.24		0.26		
Total Dispersion, β :	0.59		0.51		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Marginal				
Documentation Quality	Average				
Rationality	Superior				
Consequence Functions					
Repair Description	Epoxy injection at cracks. Paint each side.		Shore. Demolish existing wall. Construct new wall.		

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.55E+03	4.10E+03	4.68E+03	6.92E+03	8.77E+03	9.35E+03									
Best fit mean:	4.11E+03			8.34E+03											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	2.00		30.00	2.00		30.00									
Average Repair Cost (Min Qty, Max Qty)	6.15E+03		3.28E+03	1.32E+04		7.45E+03									
CV or beta (Min Qty, Max Qty)	0.11		0.11	0.11		0.11									
Quantity Unit:	100 ft² Units			100 ft² Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.77E+00	3.20E+00	3.65E+00	5.39E+00	6.83E+00	7.29E+00									
Best fit mean:	3.20E+00			6.83E+00											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	2.00		30.00	2.00		30.00									
Average Repair Time (Min Qty, Max Qty)	4.80E+00		2.56E+00	1.02E+01		5.81E+00									
CV or beta (Min Qty, Max Qty)	0.27		0.27	0.27		0.27									
Quantity Unit:	100 ft² Units			100 ft² Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		25%	0.50										
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Benson Shing														
Revisions:	None														
							Root Cost Multiplier: 100								

Root Cost Multiplier: 100

Root Cost Multiplier: 225



FEMA P-58 Fragility Specification

NISTIR Classification B1052.013
NISTIR Name Special reinforced masonry walls with fully grouted cells, 16" thick, flexure dominated up to 12' tall
Description Costing for each 100 ft*2 Wall Panel

Line 270

Construction Quality:	Not Specified			<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above)?No</div>
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	SF 100			
Demand Parameter (unit):	Story Drift Ratio	Unit less		
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	A few flexural and shear cracks with hardly noticeable residual crack widths. Slight yielding of extreme vertical reinforcement. No spalling. No fracture or buckling of vertical reinforcement. No structurally significant damage.	Numerous flexural and diagonal cracks with residual crack widths less than 1/64 in. Mild toe crushing with vertical cracks or light spalling at wall toes. No fracture or buckling of reinforcement. Small residual deformation.	Severe flexural cracks with residual crack widths greater than 1/32 in. Severe toe crushing and spalling. Fracture or buckling of vertical reinforcement. Significant residual deformation.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	B1051.003-DS2-1.JPG	B1051.003-DS3-1.JPG		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.0031	0.009	0.0151		
Data dispersion, β_d :	0.4	0.27	0.2		
Uncertainty, β_u :	0.25	0.25	0.25		
Total Dispersion, β :	0.47	0.4	0.32		

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Not Rated
Data Relevance Marginal
Documentation Quality Average
Rationality Superior

Consequence Functions
Repair Description
Cosmetic repair. Patch cracks and paint each side. Epoxy injection to repair cracks. Remove loose masonry. Patch spalls with non-shrink grout. Paint each side. Shore. - Demolish existing wall. - Construct new wall.

Long Lead Time (Yes / No)	NO			NO			NO								
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.67E+02	6.00E+02	9.33E+02	3.55E+03	4.10E+03	4.68E+03	6.92E+03	8.77E+03	9.35E+03						
Best fit mean:	5.91E+02			4.11E+03			8.34E+03								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	2.00		30.00	2.00		30.00	2.00		30.00						
Average Repair Cost (Min Qty, Max Qty)	9.00E+02		4.80E+02	6.15E+03		3.49E+03	1.32E+04		7.45E+03						
CV or beta (Min Qty, Max Qty)	0.36		0.36	0.11		0.11	0.11		0.11						
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.90E-01	4.70E-01	7.30E-01	2.77E+00	3.20E+00	3.65E+00	5.39E+00	6.83E+00	7.29E+00						
Best fit mean:	4.70E-01			3.20E+00			6.83E+00								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	2.00		30.00	2.00		30.00	2.00		30.00						
Average Repair Time (Min Qty, Max Qty)	7.04E-01		3.76E-01	4.80E+00		2.72E+00	1.02E+01		5.81E+00						
CV or beta (Min Qty, Max Qty)	0.44		0.44	0.27		0.27	0.27		0.27						
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00						
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00						
Post-event Tagging Flag:	NO			NO			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	0%		0.00	25%		0.50						

Root Cost Multiplier: 100

FEMA P-58 Fragility Specification

NISTIR Classification B1052.014
NISTIR Name Special reinforced masonry walls with fully grouted cells, 16" thick, flexure dominated greater than 12' tall
Description Costing for each 225 ft^2 Wall Panel

Line 271

Construction Quality:	Not Specified			<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above)?No</div>
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	SF 225			
Demand Parameter (unit):	Story Drift Ratio	Unit less		
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	A few flexural and shear cracks with hardly noticeable residual crack widths. Slight yielding of extreme vertical reinforcement. No spalling. No fracture or buckling of vertical reinforcement. No structurally significant damage.	Numerous flexural and diagonal cracks with residual crack widths less than 1/64 in. Mild toe crushing with vertical cracks or light spalling at wall toes. No fracture or buckling of reinforcement. Small residual deformation.	Severe flexural cracks with residual crack widths greater than 1/32 in. Severe toe crushing and spalling. Fracture or buckling of vertical reinforcement. Significant residual deformation.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	B1051.003-DS2-1.JPG	B1051.003-DS3-1.JPG		
Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ:	0.0031	0.009	0.0151		
Data dispersion, β_d:	0.4	0.27	0.2		
Uncertainty, β_u:	0.25	0.25	0.25		
Total Dispersion, β:	0.47	0.4	0.32		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings	Not Rated				
Data Quality	Marginal				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality					
Consequence Functions					
Repair Description	Cosmetic repair. Patch cracks and paint each side.	Epoxy injection to repair cracks. Remove loose masonry. Patch spalls with non-shrink grout. Paint each side.	Shore. - Demolish existing wall. - Construct new wall.		

Long Lead Time (Yes / No)	NO			NO			NO									
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	
Repair Cost by Damage State:	8.25E+02	1.35E+03	2.10E+03	7.15E+03	7.98E+03	8.85E+03	1.42E+04	1.81E+04	1.90E+04							
Best fit mean:	1.33E+03			7.96E+03			1.71E+04									
Best Fit Distribution:	LogNormal			LogNormal			Normal									
Quantity Plateau (Min Qty, Max Qty)	1.00	14.00		1.00	14.00		1.00	14.00								
Average Repair Cost (Min Qty, Max Qty)	2.03E+03		1.08E+03	1.20E+04		6.78E+03	2.72E+04		1.54E+04							
CV or beta (Min Qty, Max Qty)	0.36		0.36	0.08		0.08	0.11		0.11							
Quantity Unit:	225 ft^2 Units			225 ft^2 Units			225 ft^2 Units									
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	
Repair Time by Damage State:	6.98E-01	1.15E+00	1.80E+00	6.10E+00	6.80E+00	7.54E+00	1.21E+01	1.54E+01	1.62E+01							
Best fit mean:	1.15E+00			6.80E+00			1.54E+01									
Best Fit Distribution:	LogNormal			LogNormal			Normal									
Quantity Plateau (Min Qty, Max Qty)	1.00	14.00		1.00	14.00		1.00	14.00								
Average Repair Time (Min Qty, Max Qty)	1.72E+00		9.17E-01	1.02E+01		5.77E+00	2.32E+01		1.31E+01							
CV or beta (Min Qty, Max Qty)	0.44		0.44	0.26		0.26	0.27		0.27							
Quantity Unit:	225 ft^2 Units			225 ft^2 Units			225 ft^2 Units									
LifeSafety Hazard:																
Potential non-collapse casualties? (Yes / No)	NO			NO			NO									
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable									
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00								
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00								
Post-event Tagging Flag:	NO			NO			YES									
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	0%		0.00	25%		0.50							
Comments:	None															
Date Created:	Not Given															
Approved (YES / NO)?	By User															
Official (YES / NO) ?	By User															
Author:	Benson Shing															
Revisions:	None															
	Root Cost Multiplier: 225															

Root Cost Multiplier: 225

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1061.001a




Cold formed steel walls with wood structural panel sheathing, interior - gypsum board
Costing for each 100 ft*2 Wall Panel. Assumed framing: 38 mil cold formed steel framing with 7/16 OSB and 3/8 plywood panel sheathing with overturning restraint at each end of the wall per AISI design standard. No. 8 screws 2" to 6" OC at perimeter and 12" OC EW in field.

Line 272

Construction Quality:	High quality			<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Overturning restraint at each end of wall.			
Fragility Unit of Measure:	SF 100			
Demand Parameter (unit):	Story Drift Ratio	Unit less		
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Sheathing faster pull through or tear out. (20% of fasteners.)	Failure of structural panels.	Failure of wall.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Illustrations

				
B1061.001-DS1-1.JPG	B1061.001-DS2-1.JPG	B1061.001-DS3-1.JPG		

Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.004	0.0226	0.0267		
Data dispersion, β_d :	0.4	0.30	0.25		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.4	0.3	0.25		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Superior				
Data Relevance	Superior				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description					

Remove damaged wall, ceilings, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Replace 20% of fasteners, replace gypsum wall board, tape and sand, repaint.

Remove damaged wall, ceilings, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Replace sheathing, replace gypsum wall board, tape and sand, repaint.

Remove damaged wall, ceilings, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Provide shoring. Modify mechanical and electrical as required for repair work. Replace metal stud framing, boundary elements, sheathing, replace gypsum wall board, tape and sand, repaint.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.10E+03	3.05E+03	4.67E+03	2.00E+03	3.50E+03	5.68E+03	3.47E+03	4.50E+03	4.65E+03						
Best fit mean:	3.10E+03			3.43E+03			4.21E+03								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	2.00		30.00	2.00		30.00	2.00		30.00						
Average Repair Cost (Min Qty, Max Qty)	4.58E+03		2.44E+03	5.25E+03		2.98E+03	6.75E+03		3.83E+03						
CV or beta (Min Qty, Max Qty)	0.32		0.32	0.40		0.40	0.11		0.11						
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.04E+00	2.96E+00	4.53E+00	1.94E+00	3.40E+00	5.52E+00	3.36E+00	4.37E+00	4.51E+00						
Best fit mean:	2.96E+00			3.40E+00			4.37E+00								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	2.00		30.00	2.00		30.00	2.00		30.00						
Average Repair Time (Min Qty, Max Qty)	4.44E+00		2.37E+00	5.10E+00		2.89E+00	6.55E+00		3.71E+00						
CV or beta (Min Qty, Max Qty)	0.40		0.40	0.47		0.47	0.27		0.27						
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		25%	0.50		10%	0.50							
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														
	Root Cost Multiplier: 100														

Root Cost Multiplier: 100

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1061.001b




Cold formed steel walls with wood structural panel sheathing, exterior - stucco one side
Costing for each 100 ft*2 Wall Panel. Assumed framing: 38 mil cold formed steel framing with 7/16 OSB and 3/8 plywood panel sheathing with overturning restraint at each end of the wall per AISI design standard. No. 8 screws 2" to 6" OC at perimeter and 12" OC EW in field.

Line 273

Construction Quality:	High quality			<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Overturning restraint at each end of wall.			
Fragility Unit of Measure:	SF 100			
Demand Parameter (unit):	Story Drift Ratio	Unit less		
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Sheathing faster pull through or tear out. (20% of fasteners.)	Failure of structural panels.	Failure of wall.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Illustrations

				
B1061.001-DS1-1.JPG	B1061.001-DS2-1.JPG	B1061.001-DS3-1.JPG		

Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.004	0.0226	0.0267		
Data dispersion, β_d :	0.4	0.30	0.25		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.4	0.3	0.25		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Superior				
Data Relevance	Superior				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description					

Remove damaged wall, ceilings, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Replace 20% of fasteners, replace gypsum wall board, stucco, tape and sand, repaint.

Remove damaged wall, ceilings, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Replace sheathing, replace gypsum wall board, stucco, tape and sand, repaint.

Remove damaged wall, ceilings, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Provide shoring. Modify mechanical and electrical as required for repair work. Replace metal stud framing, boundary elements, sheathing, replace gypsum wall board, stucco, tape and sand, repaint.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.76E+03	2.19E+03	2.98E+03	3.41E+03	3.83E+03	6.06E+03	4.59E+03	5.38E+03	5.96E+03						
Best fit mean:	2.25E+03			4.27E+03			5.31E+03								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	2.00 30.00			2.00 30.00			2.00 30.00								
Average Repair Cost (Min Qty, Max Qty)	3.29E+03			5.74E+03			8.06E+03			4.57E+03					
CV or beta (Min Qty, Max Qty)	0.21 0.21			0.25 0.25			0.10 0.10								
Quantity Unit:	100 ft² Units			100 ft² Units			100 ft² Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.71E+00	2.13E+00	2.89E+00	3.31E+00	3.71E+00	5.88E+00	4.46E+00	5.22E+00	5.78E+00						
Best fit mean:	2.13E+00			3.71E+00			5.22E+00								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	2.00 30.00			2.00 30.00			2.00 30.00								
Average Repair Time (Min Qty, Max Qty)	3.19E+00			5.57E+00			7.83E+00			4.44E+00					
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.35 0.35			0.27 0.27								
Quantity Unit:	100 ft² Units			100 ft² Units			100 ft² Units								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			25% 0.50			10% 0.50								

Root Cost Multiplier: 100

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1061.011a

Cold formed steel walls with flat strap X-bracing, interior - gypsum board

Costing for each 100 ft^2 Wall Panel. Assumed framing: 33 mil cold formed steel framing with 4.5 inch x 33 mil flat strap X-bracing on one side. Straps attached to gussets with No. 8 screws.

Line 274

Construction Quality:	High quality				<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Overturning restrains required and sheathing screws driven flush with the surface of the strapping.				
Fragility Unit of Measure:	SF 100				
Demand Parameter (unit):	Story Drift Ratio	Unit less			
Number of Damage States:	2				
Damage State:	DS1	DS2			
Type of Damage State:	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Local buckling of chord studs.		Failure of many framing members and collapse.		

Illustrations					
	B1061.011-DS1-1.JPG	B1061.011-DS2-1.JPG			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.0139	0.0179			
Data dispersion, β_d :	0.25	0.25			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.25	0.25			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Average				
Data Relevance	Superior				
Documentation Quality	Average				
Rationality	Superior				
Consequence Functions					
Repair Description	Remove damaged wall, ceilings, X bracing as necessary, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Replace gypsum wall board, metal stud framing as needed, reinstall X bracing as required, tape and sand, repaint.	Remove damaged wall, ceilings, X bracing as necessary, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Replace gypsum wall board, boundary elements, metal stud framing, install X bracing, tape and sand, repaint.			

Long Lead Time (Yes / No)	NO			NO											
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.33E+03	3.12E+03	4.28E+03	3.26E+03	3.78E+03	4.19E+03									
Best fit mean:	3.14E+03			3.74E+03											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	2.00		6.00	2.00		6.00									
Average Repair Cost (Min Qty, Max Qty)	4.05E+03		2.49E+03	4.53E+03		3.21E+03									
CV or beta (Min Qty, Max Qty)	0.24		0.24	0.10		0.10									
Quantity Unit:	100 ft^2 Units			100 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.26E+00	3.03E+00	4.16E+00	3.16E+00	3.66E+00	4.07E+00									
Best fit mean:	3.03E+00			3.66E+00											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	2.00		6.00	2.00		6.00									
Average Repair Time (Min Qty, Max Qty)	3.94E+00		2.43E+00	4.39E+00		3.11E+00									
CV or beta (Min Qty, Max Qty)	0.35		0.35	0.27		0.27									
Quantity Unit:	100 ft^2 Units			100 ft^2 Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	20%	0.50		10%	0.50										
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														
	Root Cost Multiplier: 100														

Root Cost Multiplier: 100

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1061.011b

Cold formed steel walls with flat strap X-bracing, exterior - stucco one side

Costing for each 100 ft*2 Wall Panel. Assumed framing: 33 mil cold formed steel framing with 4.5 inch x 33 mil flat strap X-bracing on one side. Straps attached to gussets with No. 8 screws.

Line 275

Construction Quality:	High quality			
Seismic Installation Conditions:	Overturning restrains required and sheathing screws driven flush with the surface of the strapping.			
Fragility Unit of Measure:	SF 100			
Demand Parameter (unit):	Story Drift Ratio		Unit less	
Number of Damage States:	2			
Damage State:	DS1	DS2		
Type of Damage State:	Sequential			
DS Hierarchy	Seq(DS1,DS2)			
Descriptions	Local buckling of chord studs.		Failure of many framing members and collapse.	

Illustrations					
	B1061.011-DS1-1.JPG	B1061.011-DS2-1.JPG			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.0139	0.0179			
Data dispersion, β_d :	0.25	0.25			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.25	0.25			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Average				
Data Relevance	Superior				
Documentation Quality	Average				
Rationality	Superior				
Consequence Functions					
Repair Description	Remove damaged wall, ceilings, X bracing as necessary, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Replace gypsum wall board, stucco, metal stud framing as needed, reinstall X bracing as required, tape and sand, repaint.				

Long Lead Time (Yes / No)	NO			NO											
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.78E+03	3.08E+03	4.44E+03	4.63E+03	4.92E+03	6.35E+03									
Best fit mean:	3.36E+03			5.25E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00	8.00		3.00	8.00										
Average Repair Cost (Min Qty, Max Qty)	4.00E+03	2.46E+03		5.90E+03	4.18E+03										
CV or beta (Min Qty, Max Qty)	0.20	0.20		0.13	0.13										
Quantity Unit:	100 ft*2 Units			100 ft*2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.70E+00	2.98E+00	4.31E+00	4.50E+00	4.77E+00	6.16E+00									
Best fit mean:	2.98E+00			4.77E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00	8.00		3.00	8.00										
Average Repair Time (Min Qty, Max Qty)	3.88E+00	2.38E+00		5.72E+00	4.05E+00										
CV or beta (Min Qty, Max Qty)	0.32	0.32		0.28	0.28										
Quantity Unit:	100 ft*2 Units			100 ft*2 Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	20%	0.50		10%	0.50										
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														
	Root Cost Multiplier: 100														

Root Cost Multiplier: 100

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1061.021a

Cold formed steel walls with 22 or 31 mil steel sheathing, interior - gypsum board
Costing for each 100 ft*2 Wall Panel. Assumed framing: 33 mil cold formed steel framing with 22 or 31 mil steel sheathing attached with No. 8 screws spaced 2" or 6" OC at perimeter and 12" OC EW in the field.

Line 276

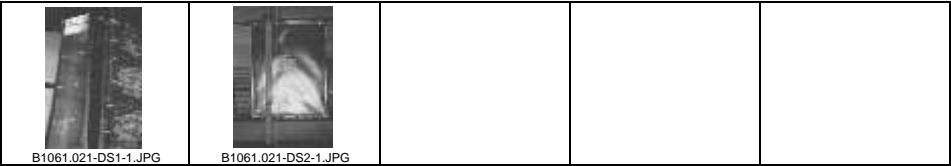
Construction Quality: High quality
Seismic Installation Conditions: Overturning restrains required and sheathing screws driven flush with the surface of the strapping.

Fragility Unit of Measure: SF 100
Demand Parameter (unit): Story Drift Ratio Unit less

Quantity Rounding Round Qty? NO
Allow sum by floor or building? NO
Demand Location (floor above?) No

Number of Damage States:	2				
Damage State:	DS1	DS2			
Type of Damage State:	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Pull out of sheathing fasteners from studs.	Buckling of steel sheathing. Buckling of framing members.			

Illustrations



Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.019	0.0253			
Data dispersion, β_d :	0.25	0.25			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.25	0.25			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Average				
Data Relevance	Superior				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Remove damaged wall, ceilings, wall finishes, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Replace 20% of fasteners, replace gypsum wall board, tape, sand, paint.	Remove damaged wall, ceilings, wall finishes, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Install new sheathing, new metal stud framing as needed, replace gypsum wall board, tape, sand, paint.			

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.10E+03	3.05E+03	4.67E+03	2.45E+03	4.15E+03	6.13E+03									
Best fit mean:	3.10E+03			4.24E+03											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	4.00		11.00	4.00		11.00									
Average Repair Cost (Min Qty, Max Qty)	3.97E+03		2.44E+03	4.98E+03		3.53E+03									
CV or beta (Min Qty, Max Qty)	0.32		0.32	0.34		0.34									
Quantity Unit:	100 ft*2 Units			100 ft*2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.04E+00	2.96E+00	4.53E+00	2.38E+00	4.03E+00	5.95E+00									
Best fit mean:	2.96E+00			4.03E+00											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	4.00		11.00	4.00		11.00									
Average Repair Time (Min Qty, Max Qty)	3.85E+00		2.37E+00	4.84E+00		3.43E+00									
CV or beta (Min Qty, Max Qty)	0.40		0.40	0.42		0.42									
Quantity Unit:	100 ft*2 Units			100 ft*2 Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	20%	0.50		10%	0.50										
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														

Root Cost Multiplier: 100

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1061.021b

Cold formed steel walls with 22 or 31 mil steel sheathing, exterior - stucco one side


Costing for each 100 ft^2 Wall Panel. Assumed framing: 33 mil cold formed steel framing with 22 or 31 mil steel sheathing attached with No. 8 screws spaced 2" or 6" OC at perimeter and 12" OC EW in the field.

Line 277

Construction Quality:	High quality				<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Overturning restrains required and sheathing screws driven flush with the surface of the strapping.				
Fragility Unit of Measure:	SF 100				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	2				
Damage State:	DS1		DS2		
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Pull out of sheathing fasteners from studs.		Buckling of steel sheathing. Buckling of framing members.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
B1061.021-DS1-1.JPG	B1061.021-DS2-1.JPG			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.019	0.0253			
Data dispersion, β_d :	0.25	0.25			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.25	0.25			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Average				
Data Relevance	Superior				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description					

Remove damaged wall, ceilings, wall finishes, mechanical, electrical, and office furniture / equipment.

Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work.

Replace 20% of fasteners, replace gypsum wall board, stucco, tape, sand, paint.

Remove damaged wall, ceilings, wall finishes, mechanical, electrical, and office furniture / equipment.

Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work.

Install new sheathing, new metal stud framing as needed, replace gypsum wall board, stucco,, tape, sand, paint.

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.89E+03	2.31E+03	3.66E+03	4.09E+03	4.78E+03	6.23E+03									
Best fit mean:	2.51E+03			4.95E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	2.00		6.00	2.00		6.00									
Average Repair Cost (Min Qty, Max Qty)	3.00E+03		1.85E+03	5.73E+03		4.06E+03									
CV or beta (Min Qty, Max Qty)	0.28		0.28	0.17		0.17									
Quantity Unit:	100 ft^2 Units			100 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.84E+00	2.24E+00	3.55E+00	3.97E+00	4.63E+00	6.04E+00									
Best fit mean:	2.24E+00			4.63E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	2.00		6.00	2.00		6.00									
Average Repair Time (Min Qty, Max Qty)	2.91E+00		1.79E+00	5.56E+00		3.93E+00									
CV or beta (Min Qty, Max Qty)	0.38		0.38	0.30		0.30									
Quantity Unit:	100 ft^2 Units			100 ft^2 Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00									
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00									
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	20%		0.50	10%		0.50									

Root Cost Multiplier: 100

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1071.001

Light framed wood walls with structural panel sheathing, gypsum wallboard no hold-downs

Costing for each 100 ft*2 Wall Panel. Assumed framing: 1 SIDE: 3/8" OSB or 15/32 ply with 8d box nails at 4 to 6 inches along panel edges and 12 inches field nailing. DF #2, 2x4@16 studs. 1 SIDE: 1/2 gypsum board. Panel 8 feet tall, 8 or 16 feet long with or without door and window openings, double top plate, single bottom plate, no hold-downs.

Line 278

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	SF 100				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Slight separation of sheathing or nails which come loose.	Permanent rotation of sheathing, tear out of nails or sheathing.	Fracture of studs, major sill plate cracking.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Illustrations

				
B1071.001-DS1-1.JPG	B1071.001-DS2-1.JPG	B1071.001-DS3-1.JPG		

Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.01	0.0175	0.025		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	0.4	0.4	0.4		
Total Dispersion, β :	0.4	0.4	0.4		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings	Not Rated				
Data Quality	Marginal				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality					
Consequence Functions					
Repair Description	Remove exterior pliable siding, replace loose nails, reinstall siding.	Remove exterior pliable siding, remove wood sheathing, install new sheathing, reinstall siding.	Remove and replace siding, sheathing, studs and plates. Provide shoring as required.		

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:		P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:		1.38E+03	1.64E+03	2.19E+03	1.71E+03	2.14E+03	2.93E+03	5.19E+03	5.38E+03	6.31E+03						
Best fit mean:		1.70E+03			2.20E+03			5.61E+03								
Best Fit Distribution:		LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)		3.00		8.00	3.00		8.00	3.00		8.00						
Average Repair Cost (Min Qty, Max Qty)		2.13E+03		1.31E+03	2.57E+03		1.82E+03	6.45E+03		4.57E+03						
CV or beta (Min Qty, Max Qty)		0.19		0.19	0.22		0.22	0.08		0.08						
Quantity Unit:		100 ft² Units			100 ft² Units			100 ft² Units								
Repair Time:		P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:		1.33E+00	1.59E+00	2.13E+00	1.66E+00	2.08E+00	2.84E+00	5.04E+00	5.22E+00	6.12E+00						
Best fit mean:		1.59E+00			2.08E+00			5.22E+00								
Best Fit Distribution:		LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)		3.00		8.00	3.00		8.00	3.00		8.00						
Average Repair Time (Min Qty, Max Qty)		2.07E+00		1.27E+00	2.50E+00		1.77E+00	6.26E+00		4.44E+00						
CV or beta (Min Qty, Max Qty)		0.31		0.31	0.33		0.33	0.26		0.26						
Quantity Unit:		100 ft² Units			100 ft² Units			100 ft² Units								
LifeSafety Hazard:		NO			NO			NO								
Potential non-collapse casualties? (Yes / No)		NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:		Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)		0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)		0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:		NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)		0%	0.00		50%	0.50		25%	0.50							
Comments:		None														
Date Created:		Not Given														
Approved (YES / NO)?		By User														
Official (YES / NO) ?		By User														
Author:		Andre Filiatrault														
Revisions:		None														
Root Cost Multiplier: 100																

Root Cost Multiplier: 100

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1071.002

Light framed wood walls with structural panel sheathing, gypsum wallboard and hold-downs

Costing for each 100 ft*2 Wall Panel. Assumed framing: 1 SIDE: 3/8" OSB or 15/32 ply with 8d box nails at 4 to 6 inches along panel edges and 12 inches field nailing. DF #2, 2x4@16 studs. 1 SIDE: 1/2 gypsum board. Panel 8 feet tall, 8 or 16 feet long with or without door and window openings, double top plate, single bottom plate, with hold-downs.

Line 281

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	SF 100				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Slight separation of sheathing or nails which come loose.	Permanent rotation of sheathing, tear out of nails or sheathing.	Fracture of studs, major sill plate cracking.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Illustrations

				
B1071.001-DS1-1.JPG	B1071.001-DS2-1.JPG	B1071.001-DS3-1.JPG		

Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.015	0.0262	0.0369		
Data dispersion, β_d :	0.26	0.16	0.17		
Uncertainty, β_u :	0.3	0.1	0.1		
Total Dispersion, β :	0.4	0.19	0.2		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Superior				
Data Relevance	Superior				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Remove exterior pliable siding, replace loose nails, reinstall siding.	Remove exterior pliable siding, remove wood sheathing, install new sheathing, reinstall siding.	Remove and replace siding, sheathing, studs and plates. Provide shoring as required.		

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.38E+03	1.64E+03	2.19E+03	1.71E+03	2.14E+03	2.93E+03	5.19E+03	5.38E+03	6.31E+03						
Best fit mean:	1.70E+03			2.20E+03			5.61E+03								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00 8.00			3.00 8.00			3.00 8.00								
Average Repair Cost (Min Qty, Max Qty)	2.13E+03			2.57E+03			6.45E+03			4.57E+03					
CV or beta (Min Qty, Max Qty)	0.19			0.22			0.08			0.08					
Quantity Unit:	100 ft² Units			100 ft² Units			100 ft² Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.33E+00	1.59E+00	2.13E+00	1.66E+00	2.08E+00	2.84E+00	5.04E+00	5.22E+00	6.12E+00						
Best fit mean:	1.59E+00			2.08E+00			5.22E+00								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00 8.00			3.00 8.00			3.00 8.00								
Average Repair Time (Min Qty, Max Qty)	2.07E+00			2.50E+00			6.26E+00			4.44E+00					
CV or beta (Min Qty, Max Qty)	0.31			0.33			0.26			0.26					
Quantity Unit:	100 ft² Units			100 ft² Units			100 ft² Units								
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			50% 0.50			25% 0.50								

Root Cost Multiplier: 100

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1071.011

Light framed wood walls with structural panel sheathing, stucco no hold-downs
Costing for each 100 ft*2 Wall Panel. Assumed framing: 1 SIDE: 3/8" OSB or 15/32 ply with 8d box nails at 4 to 6 inches along panel edges and 12 inches field nailing. DF #2, 2x4@16 studs. 1 SIDE: 1/2 gypsum board. Panel 8 feet tall, 8 or 16 feet long with or without door and window openings, double top plate, single bottom plate, with no hold-downs. Three layer 7/8" stucco with 1/2-inch chop strand fibers applied over wire mesh fastened with 1.25 -inch long staples.

Line 280

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? NO Allow sum by floor or building? NO Demand Location (floor above?) No</div>	
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	SF 100					
Demand Parameter (unit):	Story Drift RatioUnit less					
Number of Damage States:	3					
Damage State:	DS1	DS2		DS3		
Type of Damage State:	Sequential	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)					
Descriptions	Cracking of stucco.	Spalling of stucco, separation of stucco and sheathing from studs.		Fracture of studs, major sill plate cracking.		

Illustrations

				
B1071.002-DS1-1.JPG	B1071.002-DS2-1.JPG	B1071.002-DS3-1.JPG		
1.00	1.00	1.00		

Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0017	0.0035	0.017		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	0.5	0.4	0.4		
Total Dispersion, β :	0.5	0.4	0.4		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Marginal				
Documentation Quality	Average				
Rationality	Superior				
Consequence Functions					
Repair Description	Clean stucco cracks. Fill cracks with cement compound. Repaint wall to hide cracks.	Remove loose stucco and patch spalled areas with stucco. Repaint to hide repairs.	Remove and replace studs, plates, sheathing, and stucco. Shore as required.		

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	
Repair Cost by Damage State:	1.77E+03	2.30E+03	3.33E+03	1.67E+03	2.75E+03	4.35E+03	3.47E+03	4.50E+03	4.65E+03							
Best fit mean:	2.38E+03			2.72E+03			4.21E+03									
Best Fit Distribution:	LogNormal			LogNormal			Normal									
Quantity Plateau (Min Qty, Max Qty)	2.00		6.00	2.00		6.00	2.00		6.00							
Average Repair Cost (Min Qty, Max Qty)	2.99E+03		1.84E+03	3.30E+03		2.34E+03	5.40E+03		3.83E+03							
CV or beta (Min Qty, Max Qty)	0.26		0.26	0.37		0.37	0.11		0.11							
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units									
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	
Repair Time by Damage State:	1.71E+00	2.23E+00	3.24E+00	1.62E+00	2.67E+00	4.22E+00	3.36E+00	4.37E+00	4.51E+00							
Best fit mean:	2.23E+00			2.67E+00			4.37E+00									
Best Fit Distribution:	LogNormal			LogNormal			Normal									
Quantity Plateau (Min Qty, Max Qty)	2.00		6.00	2.00		6.00	2.00		6.00							
Average Repair Time (Min Qty, Max Qty)	2.90E+00		1.78E+00	3.20E+00		2.27E+00	5.24E+00		3.71E+00							
CV or beta (Min Qty, Max Qty)	0.36		0.36	0.45		0.45	0.27		0.27							
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units									
LifeSafety Hazard:	NO			NO			NO									
Potential non-collapse casualties? (Yes / No)	NO			NO			NO									
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable									
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00							
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00							
Post-event Tagging Flag:	NO			YES			YES									
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	35%		0.50	25%		0.50							
Comments:	None															
Date Created:	Not Given															
Approved (YES / NO)?	By User															
Official (YES / NO) ?	By User															
Author:	Andre Filiatrault															
Revisions:	None															
											Root Cost Multiplier:	100				

Root Cost Multiplier: 100

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B1071.012

Light framed wood walls with structural panel sheathing, stucco, hold-downs
Costing for each 100 ft*2 Wall Panel. Assumed framing: 1 SIDE: 3/8" OSB or 15/32 ply with 8d box nails at 4 to 6 inches along panel edges and 12 inches field nailing. DF #2, 2x4@16 studs. 1 SIDE: 1/2 gypsum board. Panel 8 feet tall, 8 or 16 feet long with or without door and window openings, double top plate, single bottom plate, with hold-downs. Three layer 7/8" stucco with 1/2-inch chop strand fibers applied over wire mesh fastened with 1.25 -inch long staples.

Line 279

Construction Quality:	Not Specified			
Seismic Installation Conditions:	Not Specified			
Fragility Unit of Measure:	SF 100			
Demand Parameter (unit):	Story Drift Ratio Unit less			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Cracking of stucco.	Spalling of stucco, separation of stucco and sheathing from studs.	Fracture of studs, major sill plate cracking.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	NO	

Illustrations

				
B1071.002-DS1-1.JPG	B1071.002-DS2-1.JPG	B1071.002-DS3-1.JPG		

Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0025	0.0052	0.0252		
Data dispersion, β_d :	Not Specified	0.28	0.12		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.44	0.3	0.16		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Superior				
Data Relevance	Superior				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Clean stucco cracks. Fill cracks with cement compound. Repaint wall to hide cracks.	Remove loose stucco and patch spalled areas with stucco. Repaint to hide repairs.	Remove and replace studs, plates, sheathing, and stucco. Shore as required.		

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.77E+03	2.30E+03	3.33E+03	1.67E+03	2.75E+03	4.35E+03	3.47E+03	4.50E+03	4.65E+03						
Best fit mean:	2.38E+03			2.72E+03			4.21E+03								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	2.00 6.00			2.00 6.00			2.00 6.00								
Average Repair Cost (Min Qty, Max Qty)	2.99E+03			3.30E+03			5.40E+03			3.83E+03					
CV or beta (Min Qty, Max Qty)	0.26			0.37			0.11			0.11					
Quantity Unit:	100 ft² Units			100 ft² Units			100 ft² Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.71E+00	2.23E+00	3.24E+00	1.62E+00	2.67E+00	4.22E+00	3.36E+00	4.37E+00	4.51E+00						
Best fit mean:	2.23E+00			2.67E+00			4.37E+00								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	2.00 6.00			2.00 6.00			2.00 6.00								
Average Repair Time (Min Qty, Max Qty)	2.90E+00			3.20E+00			5.24E+00			3.71E+00					
CV or beta (Min Qty, Max Qty)	0.36			0.45			0.27			0.27					
Quantity Unit:	100 ft² Units			100 ft² Units			100 ft² Units								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			35% 0.50			25% 0.50								

Root Cost Multiplier: 100

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B1071.031

Wood walls with diagonal let-in bracing

Costing for each 100 ft*2 Wall Panel. Assumed framing: Stud wall framing consists of 2 x 4's at 16 inches on center with double top plates and single sill plate. Diagonal bracing includes 2 forms. Block-bracing consists of diagonal blocking between studs that extends from the top of one edge of the panel to the bottom of the opposite edge. Diagonal bracing may also consist of let-in bracing for which a 1x or 2x brace (with same inclination as described for block-bracing) is recessed into studs. Walls may be sheathed with horizontal or vertical lumber siding.

Line 282

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

SF 100

Demand Parameter (unit):

Story Drift Ratio

Unit less

Number of Damage States:

1

Damage State:

DS1

Type of Damage State:

Sequential


DS Hierarchy

Seq(DS1)

Descriptions

Failure of diagonal bracing.

Illustrations



B1071.031-DS1-1.JPG

Damage State Probability:

1.00

Fragility Parameters

Median Demand, θ :

0.01

Data dispersion, β_d :

Not Specified

Uncertainty, β_u :

0.4

Total Dispersion, β :

0.4

Correlation (Yes / No)

NO

Directionality (Yes / No)

YES

Quality Ratings

Data Quality

Average

Data Relevance

Average

Documentation Quality

Superior

Rationality

Superior

Consequence Functions

Repair Description

Remove and replace sheathing studs, plates and bracing and replace with new stud wall construction of plywood, hold-downs, etc. Provide shoring as required.

Long Lead Time (Yes / No) NO

Repair Costs:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Cost by Damage State:	4.01E+03	4.74E+03	5.27E+03												
Best fit mean:	4.68E+03														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	4.00		11.00												
Average Repair Cost (Min Qty, Max Qty)	6.16E+03		3.79E+03												
CV or beta (Min Qty, Max Qty)	0.11		0.11												
Quantity Unit:	100 ft*2 Units														
Repair Time:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Time by Damage State:	3.89E+00	4.60E+00	5.12E+00												
Best fit mean:	4.60E+00														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	4.00		11.00												
Average Repair Time (Min Qty, Max Qty)	5.98E+00		3.68E+00												
CV or beta (Min Qty, Max Qty)	0.27		0.27												
Quantity Unit:	100 ft*2 Units														
LifeSafety Hazard:	NO														
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	YES														
Unsafe Placard Trigger (Median, Dispersion)	25%	0.50													
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Andre Filiatrault														
Revisions:	None														

Root Cost Multiplier:

100

FEMA P-58 Fragility Specification

NISTIR Classification B1071.041
NISTIR Name Exterior Wall - Type: Gypsum with wood studs, Full Height, Fixed Below, Fixed Above
Description Costing based upon 13'x100' Panels

Line 283

Construction Quality:	Normal			<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? NO</div>	
Seismic Installation Conditions:	Unknown				
Fragility Unit of Measure:	LF 100				
Demand Parameter (unit):	Story Drift RatioUnit less				
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Screws pop-out, minor cracking of wall board, warping or cracking of tape.	Moderate cracking or crushing of gypsum wall boards (typically in corners and in corners of openings).	Significant cracking and/or crushing of gypsum wall boards- buckling of studs and tearing of tracks.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.0021	0.0071	0.012		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	0.6	0.45	0.45		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Superior				
Data Relevance	Superior				
Documentation Quality	Superior				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Retape joints, paste and repaint both sides of full 100 foot length of wall board.	Remove full 100 foot length of wall board (both sides), install new wall board (both sides), tape, paste and repaint.	Remove and replace full 100 foot length of metal stud wall, both sides of the gypsum wall board and any embedded utilities, and tape, paste and repaint.		

Long Lead Time (Yes / No)	NO			NO			NO								
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	7.00E+02	2.66E+03	3.00E+03	2.05E+03	5.55E+03	8.90E+03	1.80E+04	1.88E+04	2.28E+04						
Best fit mean:	2.12E+03			5.50E+03			1.98E+04								
Best Fit Distribution:	Normal			Normal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00	10.00		1.00	10.00		1.00	10.00							
Average Repair Cost (Min Qty, Max Qty)	5.32E+03	1.60E+03		1.11E+04	3.33E+03		3.76E+04	1.13E+04							
CV or beta (Min Qty, Max Qty)	0.42	0.42		0.49	0.49		0.10	0.10							
Quantity Unit:	Each (13'x100' Panel)			Each (13'x100' Panel)			Each (13'x100' Panel)								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.20E-01	2.08E+00	2.34E+00	1.56E+00	4.29E+00	6.89E+00	1.40E+01	1.47E+01	1.78E+01						
Best fit mean:	2.08E+00			4.29E+00			1.47E+01								
Best Fit Distribution:	Normal			Normal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00	10.00		1.00	10.00		1.00	10.00							
Average Repair Time (Min Qty, Max Qty)	4.15E+00	1.25E+00		8.62E+00	2.56E+00		2.93E+01	8.83E+00							
CV or beta (Min Qty, Max Qty)	0.49	0.49		0.55	0.55		0.27	0.27							
Quantity Unit:	Each (13'x100' Panel)			Each (13'x100' Panel)			Each (13'x100' Panel)								
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			NO								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Comments:	Copy of C1011.011a for use as an exterior wall.														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														
	Root Cost Multiplier: 1300														

Root Cost Multiplier: 1300

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B2011.001a




Exterior Wall - Cold formed steel walls with wood structural panel sheathing, interior - gypsum board
Costing for each 100 ft*2 Wall Panel. Assumed framing: 38 mil cold formed steel framing with 7/16 OSB and 3/8 plywood panel sheathing with overturning restraint at each end of the wall per AISI design standard. No. 8 screws 2" to 6" OC at perimeter and 12" OC EW in field.

Line 284

Construction Quality:	High quality			<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Overturning restraint at each end of wall.			
Fragility Unit of Measure:	SF 100			
Demand Parameter (unit):	Story Drift Ratio	Unit less		
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Seq(DS1,DS2,DS3) Sheathing faster pull through or tear out. (20% of fasteners.)	Failure of structural panels.	Failure of wall.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	NO	

Illustrations

				
B1061.001-DS1-1.JPG	B1061.001-DS2-1.JPG	B1061.001-DS3-1.JPG		
1.00	1.00	1.00		

Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.004	0.0226	0.0267		
Data dispersion, β_d :	0.4	0.30	0.25		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.4	0.3	0.25		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Superior				
Data Relevance	Superior				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description					

Remove damaged wall, ceilings, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Replace 20% of fasteners, replace gypsum wall board, tape and sand, repaint.

Remove damaged wall, ceilings, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Replace sheathing, replace gypsum wall board, tape and sand, repaint.

Remove damaged wall, ceilings, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Provide shoring. Modify mechanical and electrical as required for repair work. Replace metal stud framing, boundary elements, sheathing, replace gypsum wall board, tape and sand, repaint.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.10E+03	3.05E+03	4.67E+03	2.00E+03	3.50E+03	5.68E+03	3.47E+03	4.50E+03	4.65E+03						
Best fit mean:	3.10E+03			3.43E+03			4.21E+03								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	6.00 30.00			6.00 30.00			6.00 30.00								
Average Repair Cost (Min Qty, Max Qty)	3.97E+03 0.32			4.20E+03 0.40			5.40E+03 0.11								
CV or beta (Min Qty, Max Qty)	0.32			0.40			0.11								
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.64E+00	2.38E+00	3.64E+00	1.56E+00	2.73E+00	4.43E+00	2.70E+00	3.51E+00	3.62E+00						
Best fit mean:	2.38E+00			2.73E+00			3.51E+00								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	6.00 30.00			6.00 30.00			6.00 30.00								
Average Repair Time (Min Qty, Max Qty)	3.09E+00 0.40			3.28E+00 0.47			4.21E+00 0.27								
CV or beta (Min Qty, Max Qty)	0.40			0.47			0.27								
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			25% 0.50			10% 0.50								

Comments: Copy of B1061.001a for use as an exterior wall.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: None

Root Cost Multiplier: 100

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B2011.001b




Exterior Wall - Cold formed steel walls with wood structural panel sheathing, exterior - stucco one side
Costing for each 100 ft*2 Wall Panel. Assumed framing: 38 mil cold formed steel framing with 7/16 OSB and 3/8 plywood panel sheathing with overturning restraint at each end of the wall per AISI design standard. No. 8 screws 2" to 6" OC at perimeter and 12" OC EW in field.

Line 285

Construction Quality:	High quality			<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Overturning restraint at each end of wall.			
Fragility Unit of Measure:	SF 100			
Demand Parameter (unit):	Story Drift Ratio	Unit less		
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Seq(DS1,DS2,DS3) Sheathing faster pull through or tear out. (20% of fasteners.)	Failure of structural panels.	Failure of wall.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	NO	

Illustrations

				
B1061.001-DS1-1.JPG	B1061.001-DS2-1.JPG	B1061.001-DS3-1.JPG		
1.00	1.00	1.00		

Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.004	0.0226	0.0267		
Data dispersion, β_d :	0.4	0.30	0.25		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.4	0.3	0.25		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Superior				
Data Relevance	Superior				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description					

Remove damaged wall, ceilings, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Replace 20% of fasteners, replace gypsum wall board, stucco, tape and sand, repaint.

Remove damaged wall, ceilings, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Replace sheathing, replace gypsum wall board, stucco, tape and sand, repaint.

Remove damaged wall, ceilings, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Provide shoring. Modify mechanical and electrical as required for repair work. Replace metal stud framing, boundary elements, sheathing, replace gypsum wall board, stucco, tape and sand, repaint.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Cost by Damage State:	1.76E+03	2.19E+03	2.98E+03	3.41E+03	3.83E+03	6.06E+03	4.59E+03	5.38E+03	5.96E+03						
Best fit mean:	2.25E+03			4.27E+03			5.31E+03								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	6.00 30.00			6.00 30.00			6.00 30.00								
Average Repair Cost (Min Qty, Max Qty)	2.85E+03 0.21			4.59E+03 0.25			6.45E+03 0.10								
CV or beta (Min Qty, Max Qty)	0.21 0.21			0.25 0.25			0.10 0.10								
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Repair Time:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Time by Damage State:	1.37E+00	1.71E+00	2.32E+00	2.66E+00	2.98E+00	4.72E+00	3.58E+00	4.19E+00	4.64E+00						
Best fit mean:	1.71E+00			2.98E+00			4.19E+00								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	6.00 30.00			6.00 30.00			6.00 30.00								
Average Repair Time (Min Qty, Max Qty)	2.22E+00 0.33			3.58E+00 0.35			5.03E+00 0.27								
CV or beta (Min Qty, Max Qty)	0.33 0.33			0.35 0.35			0.27 0.27								
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			25% 0.50			10% 0.50								

Comments: Copy of B1061.001b for use as an exterior wall.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: None

Root Cost Multiplier: 100

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2011.011a


Exterior Wall - Cold formed steel walls with flat strap X-bracing, interior - gypsum board

Costing for each 100 ft^2 Wall Panel. Assumed framing: 33 mil cold formed steel framing with 4.5 inch x 33 mil flat strap X-bracing on one side. Straps attached to gussets with No. 8 screws.


Line 286

Construction Quality:	High quality				<div>Quantity Rounding Round Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? NO</div>	
Seismic Installation Conditions:	Overturning restrains required and sheathing screws driven flush with the surface of the strapping.					
Fragility Unit of Measure:	SF 100					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Local buckling of chord studs.		Failure of many framing members and collapse.			

Illustrations



B1061.011-DS1-1.JPG



B1061.011-DS2-1.JPG

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.0139	0.0179			
Data dispersion, β_d :	0.25	0.25			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.25	0.25			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Average				
Data Relevance	Superior				
Documentation Quality	Average				
Rationality	Superior				
Consequence Functions					
Repair Description	<div><div>Remove damaged wall, ceilings, X bracing as necessary, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Replace gypsum wall board, metal stud framing as needed, reinstall X bracing as required, tape and sand, repaint.</div><div>Remove damaged wall, ceilings, X bracing as necessary, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Replace gypsum wall board, boundary elements, metal stud framing, install X bracing, tape and sand, repaint.</div></div>				

Long Lead Time (Yes / No)				NO			NO											
Repair Costs:				P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:				2.33E+03	3.12E+03	4.28E+03	3.26E+03	3.78E+03	4.19E+03									
Best fit mean:				3.14E+03			3.74E+03											
Best Fit Distribution:				LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)				2.00		6.00	2.00		6.00									
Average Repair Cost (Min Qty, Max Qty)				4.05E+03		2.49E+03	4.53E+03		3.21E+03									
CV or beta (Min Qty, Max Qty)				0.24		0.24	0.10		0.10									
Quantity Unit:				100 ft² Units			100 ft² Units											
Repair Time:				P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:				1.81E+00	2.43E+00	3.34E+00	2.54E+00	2.94E+00	3.27E+00									
Best fit mean:				2.43E+00			2.94E+00											
Best Fit Distribution:				LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)				2.00		6.00	2.00		6.00									
Average Repair Time (Min Qty, Max Qty)				3.16E+00		1.94E+00	3.53E+00		2.50E+00									
CV or beta (Min Qty, Max Qty)				0.35		0.35	0.27		0.27									
Quantity Unit:				100 ft² Units			100 ft² Units											
LifeSafety Hazard:																		
Potential non-collapse casualties? (Yes / No)				NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:				Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)				0%		0.00	0%		0.00									
Loss of Life (Median, Dispersion)				0%		0.00	0%		0.00									
Post-event Tagging Flag:				YES			YES											
Unsafe Placard Trigger (Median, Dispersion)				20%		0.50	10%		0.50									
Comments:				Copy of B1061.011a for use as an exterior wall.														
Date Created:				Not Given														
Approved (YES / NO)?				By User														
Official (YES / NO) ?				By User														
Author:				Not Given														
Revisions:				None														
				Root Cost Multiplier: 100														

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2011.011b

Exterior Wall - Cold formed steel walls with flat strap X-bracing, exterior - stucco one side

Costing for each 100 ft*2 Wall Panel. Assumed framing: 33 mil cold formed steel framing with 4.5 inch x 33 mil flat strap X-bracing on one side. Straps attached to gussets with No. 8 screws.

Line 287

Construction Quality:	High quality				Quantity Rounding		Round Qty?	NO
Seismic Installation Conditions:	Overturning restrains required and sheathing screws driven flush with the surface of the strapping.				Allow sum by floor or building?		NO	
Fragility Unit of Measure:	SF 100				Demand Location (floor above)?		NO	
Demand Parameter (unit):	Story Drift Ratio		Unit less					
Number of Damage States:	2							
Damage State:	DS1		DS2					
Type of Damage State:	Sequential		Sequential					
DS Hierarchy	Seq(DS1,DS2)							
Descriptions	Local buckling of chord studs.		Failure of many framing members and collapse.					

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Illustrations					
	B1061.011-DS1-1.JPG	B1061.011-DS2-1.JPG			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.0139	0.0179			
Data dispersion, β_d :	0.25	0.25			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.25	0.25			

Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Average				
Data Relevance	Superior				
Documentation Quality	Average				
Rationality	Superior				
Consequence Functions					
Repair Description	Remove damaged wall, ceilings, X bracing as necessary, mechanical, electrical, and office furniture / equipment. Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work. Replace gypsum wall board, stucco, metal stud framing as needed, reinstall X bracing as required, tape and sand, repaint.				

Long Lead Time (Yes / No)				NO			NO																			
Repair Costs:													P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀		
Repair Cost by Damage State:													2.78E+03	3.08E+03	4.44E+03	4.63E+03	4.92E+03	6.35E+03								
Best fit mean:													3.36E+03			5.25E+03										
Best Fit Distribution:													LogNormal			LogNormal										
Quantity Plateau (Min Qty, Max Qty)													3.00		8.00		3.00		8.00							
Average Repair Cost (Min Qty, Max Qty)													4.00E+03		2.46E+03		5.90E+03		4.18E+03							
CV or beta (Min Qty, Max Qty)													0.20		0.20		0.13		0.13							
Quantity Unit:													100 ft*2 Units			100 ft*2 Units										
Repair Time:													P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀		
Repair Time by Damage State:													2.17E+00	2.40E+00	3.46E+00	3.61E+00	3.83E+00	4.95E+00								
Best fit mean:													2.40E+00			3.83E+00										
Best Fit Distribution:													LogNormal			LogNormal										
Quantity Plateau (Min Qty, Max Qty)													3.00		8.00		3.00		8.00							
Average Repair Time (Min Qty, Max Qty)													3.12E+00		1.92E+00		4.60E+00		3.26E+00							
CV or beta (Min Qty, Max Qty)													0.32		0.32		0.28		0.28							
Quantity Unit:													100 ft*2 Units			100 ft*2 Units										
LifeSafety Hazard:																										
Potential non-collapse casualties? (Yes / No)													NO			NO										
Casualty-affected Planar Area (sf) per Normative Unit:													Not Applicable			Not Applicable										
Serious Injury (Median, Dispersion)													0%		0.00		0%		0.00							
Loss of Life (Median, Dispersion)													0%		0.00		0%		0.00							
Post-event Tagging Flag:													YES			YES										
Unsafe Placard Trigger (Median, Dispersion)													20%		0.50		10%		0.50							
Comments:													Copy of B1061.011b for use as an exterior wall.													
Date Created:													Not Given													
Approved (YES / NO)?													By User													
Official (YES / NO) ?													By User													
Author:													Not Given													
Revisions:													None													
													Root Cost Multiplier: 100													

Root Cost Multiplier: 100

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2011.021a

Exterior Wall - Cold formed steel walls with 22 or 31 mil steel sheathing, interior - gypsum board
Costing for each 100 ft^2 Wall Panel. Assumed framing: 33 mil cold formed steel framing with 22 or 31 mil steel sheathing attached with No. 8 screws spaced 2" or 6" OC at perimeter and 12" OC EW in the field.

Line 288

Construction Quality:	High quality				<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Overturning restrains required and sheathing screws driven flush with the surface of the strapping.				
Fragility Unit of Measure:	SF 100				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	2				
Damage State:	DS1		DS2		
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Pull out of sheathing fasteners from studs.		Buckling of steel sheathing. Buckling of framing members.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	NO	

Illustrations

				
B1061.021-DS1-1.JPG	B1061.021-DS2-1.JPG			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.019	0.0253			
Data dispersion, β_d :	0.25	0.25			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.25	0.25			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Average				
Data Relevance	Superior				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description					

Remove damaged wall, ceilings, wall finishes, mechanical, electrical, and office furniture / equipment.
Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work.
Replace 20% of fasteners, replace gypsum wall board, tape, sand, paint.

Remove damaged wall, ceilings, wall finishes, mechanical, electrical, and office furniture / equipment.
Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work.
Install new sheathing, new metal stud framing as needed, replace gypsum wall board, tape, sand, paint.

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.10E+03	3.05E+03	4.67E+03	2.45E+03	4.15E+03	6.13E+03									
Best fit mean:	3.10E+03			4.24E+03											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	4.00 11.00			4.00 11.00											
Average Repair Cost (Min Qty, Max Qty)	3.97E+03 2.44E+03			4.98E+03 3.53E+03											
CV or beta (Min Qty, Max Qty)	0.32 0.32			0.34 0.34											
Quantity Unit:	100 ft^2 Units			100 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.64E+00	2.38E+00	3.64E+00	1.91E+00	3.23E+00	4.78E+00									
Best fit mean:	2.38E+00			3.23E+00											
Best Fit Distribution:	LogNormal			Normal											
Quantity Plateau (Min Qty, Max Qty)	4.00 11.00			4.00 11.00											
Average Repair Time (Min Qty, Max Qty)	3.09E+00 1.90E+00			3.88E+00 2.74E+00											
CV or beta (Min Qty, Max Qty)	0.40 0.40			0.42 0.42											
Quantity Unit:	100 ft^2 Units			100 ft^2 Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	20% 0.50			10% 0.50											
Comments:	Copy of B1061.021a for use as an exterior wall.														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														

Root Cost Multiplier: 100

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B2011.021b

Exterior Wall - Cold formed steel walls with 22 or 31 mil steel sheathing, exterior - stucco one side
Costing for each 100 ft*2 Wall Panel. Assumed framing: 33 mil cold formed steel framing with 22 or 31 mil steel sheathing attached with No. 8 screws spaced 2" or 6" OC at perimeter and 12" OC EW in the field.

Line 289



Construction Quality: High quality
Seismic Installation Conditions: Overturning restrains required and sheathing screws driven flush with the surface of the strapping.

Fragility Unit of Measure:	SF 100
Demand Parameter (unit):	Story Drift Ratio Unit less
Number of Damage States:	2

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Damage State:	DS1	DS2			
Type of Damage State:	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Pull out of sheathing fasteners from studs.	Buckling of steel sheathing. Buckling of framing members.			

Illustrations

				
B1061.021-DS1-1.JPG	B1061.021-DS2-1.JPG			
1.00	1.00			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.019	0.0253			
Data dispersion, β_d :	0.25	0.25			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.25	0.25			

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Average
Data Relevance Superior
Documentation Quality Superior
Rationality Superior

Consequence Functions
Repair Description
Remove damaged wall, ceilings, wall finishes, mechanical, electrical, and office furniture / equipment.
Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work.
Replace 20% of fasteners, replace gypsum wall board, stucco, tape, sand, paint.

Remove damaged wall, ceilings, wall finishes, mechanical, electrical, and office furniture / equipment.
Temporarily protect floor and provide dust curtains. Modify mechanical and electrical as required for repair work.
Install new sheathing, new metal stud framing as needed, replace gypsum wall board, stucco, tape, sand, paint.

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.89E+03	2.31E+03	3.66E+03	4.09E+03	4.78E+03	6.23E+03									
Best fit mean:	2.51E+03			4.85E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	2.00 6.00			2.00 6.00											
Average Repair Cost (Min Qty, Max Qty)	3.00E+03			5.73E+03			4.06E+03								
CV or beta (Min Qty, Max Qty)	0.28 0.28			0.17 0.17											
Quantity Unit:	100 ft*2 Units			100 ft*2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.47E+00	1.80E+00	2.85E+00	3.19E+00	3.72E+00	4.85E+00									
Best fit mean:	1.80E+00			3.72E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	2.00 6.00			2.00 6.00											
Average Repair Time (Min Qty, Max Qty)	2.34E+00			4.46E+00			3.16E+00								
CV or beta (Min Qty, Max Qty)	0.38 0.38			0.30 0.30											
Quantity Unit:	100 ft*2 Units			100 ft*2 Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	20% 0.50			10% 0.50											

Comments: Copy of B1061.021b for use as an exterior wall.

Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: None

Root Cost Multiplier: 100

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B2011.101

Exterior Wall - Light framed wood walls with structural panel sheathing, gypsum wallboard no hold-downs

Costing for each 100 ft*2 Wall Panel. Assumed framing: 1 SIDE: 3/8" OSB or 15/32 ply with 8d box nails at 4 to 6 inches along panel edges and 12 inches field nailing. DF #2, 2x4@16 studs. 1 SIDE: 1/2 gypsum board. Panel 8 feet tall, 8 or 16 feet long with or without door and window openings, double top plate, single bottom plate, no hold-downs.

Line 290

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	SF 100				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Slight separation of sheathing or nails which come loose.	Permanent rotation of sheathing, tear out of nails or sheathing.	Fracture of studs, major sill plate cracking.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Illustrations

				
B1071.001-DS1-1.JPG	B1071.001-DS2-1.JPG	B1071.001-DS3-1.JPG		

Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.01	0.0175	0.025		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	0.4	0.4	0.4		
Total Dispersion, β :	0.4	0.4	0.4		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings	Not Rated				
Data Quality	Marginal				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality					
Consequence Functions					
Repair Description	Remove exterior pliable siding, replace loose nails, reinstall siding.	Remove exterior pliable siding, remove wood sheathing, install new sheathing, reinstall siding.	Remove and replace siding, sheathing, studs and plates. Provide shoring as required.		

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.77E+03	2.30E+03	3.33E+03	1.67E+03	2.75E+03	4.35E+03	3.47E+03	4.50E+03	4.65E+03						
Best fit mean:	2.38E+03			2.72E+03			4.21E+03								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 8.00			3.00 8.00			3.00 8.00								
Average Repair Cost (Min Qty, Max Qty)	2.99E+03 0.26			3.30E+03 0.37			5.40E+03 0.11								
CV or beta (Min Qty, Max Qty)	0.26			0.37			0.11								
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.38E+00	1.79E+00	2.60E+00	1.30E+00	2.14E+00	3.39E+00	2.70E+00	3.51E+00	3.62E+00						
Best fit mean:	1.79E+00			2.14E+00			3.51E+00								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 8.00			3.00 8.00			3.00 8.00								
Average Repair Time (Min Qty, Max Qty)	2.33E+00 0.36			2.57E+00 0.45			4.21E+00 0.27								
CV or beta (Min Qty, Max Qty)	0.36			0.45			0.27								
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			50% 0.50			25% 0.50								

Comments: Copy of B1071.001 for use as an exterior wall.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Andre Filiatrault
Revisions: None

Root Cost Multiplier: 100

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description




B2011.102

Exterior Wall - Light framed wood walls with structural panel sheathing, stucco, hold-downs
Costing for each 100 ft*2 Wall Panel. Assumed framing: 1 SIDE: 3/8" OSB or 15/32 ply with 8d box nails at 4 to 6 inches along panel edges and 12 inches field nailing. DF #2, 2x4@16 studs. 1 SIDE: 1/2 gypsum board. Panel 8 feet tall, 8 or 16 feet long with or without door and window openings, double top plate, single bottom plate, with hold-downs. Three layer 7/8" stucco with 1/2-inch chop strand fibers applied over wire mesh fastened with 1.25 -inch long staples.

Line 291

Construction Quality:	Not Specified				<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) No</div>	
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	SF 100					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	3					
Damage State:	DS1	DS2	DS3			
Type of Damage State:	Sequential		Sequential		Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)					
Descriptions	Cracking of stucco.		Spalling of stucco, separation of stucco and sheathing from studs.		Fracture of studs, major sill plate cracking.	

Illustrations

					
	B1071.002-DS1-1.JPG	B1071.002-DS2-1.JPG	B1071.002-DS3-1.JPG		
Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0025	0.0052	0.0252		
Data dispersion, β_d :	0.43	0.28	0.12		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.44	0.3	0.16		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Superior				
Data Relevance	Superior				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Clean stucco cracks. Fill cracks with cement compound. Repaint wall to hide cracks.				
	Remove loose stucco and patch spalled areas with stucco. Repaint to hide repairs.		Remove and replace studs, plates, sheathing, and stucco. Shore as required.		

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.38E+03	1.64E+03	2.19E+03	1.71E+03	2.14E+03	2.93E+03	4.27E+03	4.80E+03	5.70E+03						
Best fit mean:	1.70E+03			2.20E+03			4.89E+03								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	4.00		11.00	4.00		11.00	4.00		11.00						
Average Repair Cost (Min Qty, Max Qty)	2.13E+03		1.31E+03	2.57E+03		1.82E+03	5.76E+03		4.08E+03						
CV or beta (Min Qty, Max Qty)	0.19		0.19	0.22		0.22	0.12		0.12						
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.07E+00	1.28E+00	1.71E+00	1.33E+00	1.67E+00	2.28E+00	3.33E+00	3.74E+00	4.44E+00						
Best fit mean:	1.28E+00			1.67E+00			3.74E+00								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	4.00		11.00	4.00		11.00	4.00		11.00						
Average Repair Time (Min Qty, Max Qty)	1.66E+00		1.02E+00	2.00E+00		1.42E+00	4.49E+00		3.18E+00						
CV or beta (Min Qty, Max Qty)	0.31		0.31	0.33		0.33	0.28		0.28						
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00						
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00						
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	35%		0.50	25%		0.50						
Comments:	Copy of B1071.002 for use as an exterior wall.														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Andre Filiatrault														
Revisions:	None														
											Root Cost Multiplier:		100		

Root Cost Multiplier: 100

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B2011.111

Exterior Wall - Light framed wood walls with structural panel sheathing, stucco no hold-downs

Costing for each 100 ft*2 Wall Panel. Assumed framing: 1 SIDE: 3/8" OSB or 15/32 ply with 8d box nails at 4 to 6 inches along panel edges and 12 inches field nailing. DF #2, 2x4@16 studs. 1 SIDE: 1/2 gypsum board. Panel 8 feet tall, 8 or 16 feet long with or without door and window openings, double top plate, single bottom plate, with no hold-downs. Three layer 7/8" stucco with 1/2-inch chop strand fibers applied over wire mesh fastened with 1.25 -inch long staples.

Line 292

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

SF 100

Demand Parameter (unit):

Story Drift Ratio

Unit less

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Cracking of stucco.

Spalling of stucco, separation of stucco and sheathing from studs.

Fracture of studs, major sill plate cracking.

Illustrations



B1071.002-DS1-1.JPG



B1071.002-DS2-1.JPG



B1071.002-DS3-1.JPG

Damage State Probability:

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0017

0.0035

0.017

Data dispersion, β_d :

Not Specified

Not Specified

Not Specified

Uncertainty, β_u :

0.5

0.4

0.4

Total Dispersion, β :

0.5

0.4

0.4

Correlation (Yes / No)

NO

Directionality (Yes / No)

YES

Quality Ratings

Data Quality

Not Rated

Data Relevance

Marginal

Documentation Quality

Average

Rationality

Superior

Consequence Functions

Repair Description

Clean stucco cracks. Fill cracks with cement compound. Repaint wall to hide cracks.

Remove loose stucco and patch spalled areas with stucco. Repaint to hide repairs.

Remove and replace studs, plates, sheathing, and stucco. Shore as required.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

P_{10}

P_{50}

P_{90}

P_{10}

P_{50}

P_{90}

P_{10}

P_{50}

P_{90}

P_{10}

P_{50}

P_{90}

P_{10}

P_{50}

P_{90}

1.77E+03

2.30E+03

3.33E+03

1.67E+03

2.75E+03

4.35E+03

3.47E+03

4.50E+03

4.65E+03

Best fit mean:

2.38E+03

2.72E+03

4.21E+03

Best Fit Distribution:

LogNormal

LogNormal

Normal

Quantity Plateau

2.00

6.00

2.00

6.00

2.00

6.00

Average Repair Cost (Min Qty, Max Qty)

2.99E+03

1.84E+03

3.30E+03

2.34E+03

5.40E+03

3.83E+03

CV or beta (Min Qty, Max Qty)

0.26

0.26

0.37

0.37

0.11

0.11

Quantity Unit:

100 ft*2 Units

100 ft*2 Units

100 ft*2 Units

Repair Time:

Repair Time by Damage State:

P_{10}

P_{50}

P_{90}

P_{10}

P_{50}

P_{90}

P_{10}

P_{50}

P_{90}

P_{10}

P_{50}

P_{90}

P_{10}

P_{50}

P_{90}

1.38E+00

1.79E+00

2.60E+00

1.30E+00

2.14E+00

3.39E+00

2.70E+00

3.51E+00

3.62E+00

Best fit mean:

1.79E+00

2.14E+00

3.51E+00

Best Fit Distribution:

LogNormal

LogNormal

Normal

Quantity Plateau

2.00

6.00

2.00

6.00

2.00

6.00

Average Repair Time (Min Qty, Max Qty)

2.33E+00

1.43E+00

2.57E+00

1.82E+00

4.21E+00

2.98E+00

CV or beta (Min Qty, Max Qty)

0.36

0.36

0.45

0.45

0.27

0.27

Quantity Unit:

100 ft*2 Units

100 ft*2 Units

100 ft*2 Units

LifeSafety Hazard:

Potential non-collapse casualties?

(Yes / No)

NO

NO

NO

Casualty-affected Planar Area (sf)

per Normative Unit:

Not Applicable

Not Applicable

Not Applicable

Serious Injury (Median, Dispersion)

0%

0.00

0%

0.00

0%

0.00

Loss of Life (Median, Dispersion)

0%

0.00

0%

0.00

0%

0.00

Post-event Tagging Flag:

NO

YES

YES

Unsafe Placard Trigger (Median, Dispersion)

0%

0.00

35%

0.50

25%

0.50

Comments:

Copy of B1071.011 for use as an exterior wall.

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Andre Filiatrault

Revisions:

None

Root Cost Multiplier: 100

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B2011.121

Exterior Wall - Light framed wood walls with structural panel sheathing, gypsum wallboard and hold-downs

Costing for each 100 ft*2 Wall Panel. Assumed framing: 1 SIDE: 3/8" OSB or 15/32 ply with 8d box nails at 4 to 6 inches along panel edges and 12 inches field nailing. DF #2, 2x4@16 studs. 1 SIDE: 1/2 gypsum board. Panel 8 feet tall, 8 or 16 feet long with or without door and window openings, double top plate, single bottom plate, with hold-downs.

Line 293

Construction Quality: Not Specified
Seismic Installation Conditions: Not Specified

Fragility Unit of Measure:	SF 100
Demand Parameter (unit):	Story Drift Ratio Unit less
Number of Damage States:	3

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Slight separation of sheathing or nails which come loose.	Permanent rotation of sheathing, tear out of nails or sheathing.	Fracture of studs, major sill plate cracking.		

Illustrations

				
B1071.001-DS1-1.JPG	B1071.001-DS2-1.JPG	B1071.001-DS3-1.JPG		

Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.015	0.0262	0.0369		
Data dispersion, β_d :	0.26	0.16	0.17		
Uncertainty, β_u :	0.3	0.1	0.1		
Total Dispersion, β :	0.4	0.19	0.2		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Superior				
Data Relevance	Superior				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Remove exterior pliable siding, replace loose nails, reinstall siding.	Remove exterior pliable siding, remove wood sheathing, install new sheathing, reinstall siding.	Remove and replace siding, sheathing, studs and plates. Provide shoring as required.		

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.38E+03	1.64E+03	2.19E+03	1.71E+03	2.14E+03	2.93E+03	5.19E+03	5.38E+03	6.31E+03						
Best fit mean:	1.70E+03			2.20E+03			5.61E+03								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00	8.00		3.00	8.00		3.00	8.00							
Average Repair Cost (Min Qty, Max Qty)	2.13E+03	1.31E+03		2.57E+03	1.82E+03		6.45E+03	4.57E+03							
CV or beta (Min Qty, Max Qty)	0.19	0.19		0.22	0.22		0.08	0.08							
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.07E+00	1.28E+00	1.71E+00	1.33E+00	1.67E+00	2.28E+00	4.05E+00	4.19E+00	4.92E+00						
Best fit mean:	1.28E+00			1.67E+00			4.19E+00								
Best Fit Distribution:	LogNormal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	3.00	8.00		3.00	8.00		3.00	8.00							
Average Repair Time (Min Qty, Max Qty)	1.66E+00	1.02E+00		2.00E+00	1.42E+00		5.03E+00	3.56E+00							
CV or beta (Min Qty, Max Qty)	0.31	0.31		0.33	0.33		0.26	0.26							
Quantity Unit:	100 ft*2 Units			100 ft*2 Units			100 ft*2 Units								
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		50%	0.50		25%	0.50							

Comments: Copy of B1071.021 for use as an exterior wall.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Andre Filiatrault

Revisions: 2011-08-24 Negative probability below 0.5% drift - overlap deemed acceptable.

Root Cost Multiplier: 100

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2011.131

Exterior Wall - Wood walls with diagonal let-in bracing

Costing for each 100 ft*2 Wall Panel. Assumed framing: Stud wall framing consists of 2 x 4's at 16 inches on center with double top plates and single sill plate. Diagonal bracing includes 2 forms. Block-bracing consists of diagonal blocking between studs that extends from the top of one edge of the panel to the bottom of the opposite edge. Diagonal bracing may also consist of let-in bracing for which a 1x or 2x brace (with same inclination as described for block-bracing) is recessed into studs. Walls may be sheathed with horizontal or vertical lumber siding.

Line 294

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

SF 100

Demand Parameter (unit):

Story Drift Ratio

Unit less

Number of Damage States:

1

Damage State:

DS1

Type of Damage State:

Sequential


DS Hierarchy

Seq(DS1)

Descriptions

Failure of diagonal bracing.

Illustrations



B1071.031-DS1-1.JPG

Damage State Probability:

1.00

Fragility Parameters

Median Demand, θ :

0.01

Data dispersion, β_d :

Not Specified

Uncertainty, β_u :

0.4

Total Dispersion, β :

0.4

Correlation (Yes / No)

NO

Directionality (Yes / No)

YES

Quality Ratings

Data Quality

Average

Data Relevance

Average

Documentation Quality

Superior

Rationality

Superior

Consequence Functions

Repair Description

Remove and replace sheathing studs, plates and bracing and replace with new stud wall construction of plywood, hold-downs, etc. Provide shoring as required.

Long Lead Time (Yes / No) NO

Repair Costs:

Repair Cost by Damage State:

P₁₀

P₅₀

P₉₀

4.01E+03

4.74E+03

5.27E+03

Best fit mean:

4.68E+03

Best Fit Distribution:

Normal

Quantity Plateau (Min Qty, Max Qty)

4.00

11.00

Average Repair Cost (Min Qty, Max Qty)

6.16E+03

3.79E+03

CV or beta (Min Qty, Max Qty)

0.11

0.11

Quantity Unit:

100 ft*2 Units

Repair Time:

Repair Time by Damage State:

P₁₀

P₅₀

P₉₀

3.13E+00

3.70E+00

4.11E+00

Best fit mean:

3.70E+00

Best Fit Distribution:

Normal

Quantity Plateau (Min Qty, Max Qty)

4.00

11.00

Average Repair Time (Min Qty, Max Qty)

4.81E+00

2.96E+00

CV or beta (Min Qty, Max Qty)

0.27

0.27

Quantity Unit:

100 ft*2 Units

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

NO

Casualty-affected Planar Area (sf) per Normative Unit:

Not Applicable

Serious Injury (Median, Dispersion)

0%

0.00

Loss of Life (Median, Dispersion)

0%

0.00

Post-event Tagging Flag:

YES

Unsafe Placard Trigger (Median, Dispersion)

25%

0.50

Comments:

Copy of B1071.031 for use as an exterior wall.

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Andre Filiatrault

Revisions:

None

Root Cost Multiplier:

100

FEMA P-58 Fragility Specification

NISTIR Classification B2011.201a
NISTIR Name Precast Concrete Panels 4.5 inches thick - in plane deformation
Description Costing is based upon 30"x13" panels.

Line 295

Construction Quality:	Not Specified					Quantity Rounding		Round Qty?	NO
Seismic Installation Conditions:	All					Allow sum by floor or building?		NO	
Fragility Unit of Measure:	LF 30					Demand Location (floor above)?		No	
Demand Parameter (unit):	Story Drift Ratio		Unit less						
Number of Damage States:	2								
Damage State:	DS1		DS2						
Type of Damage State:	Mutually Exclusive		Mutually Exclusive						
DS Hierarchy	MutEx(DS1,DS2)								
Descriptions	Cladding units damaged by impact at corners at column covers. Damage in field is either attributed to natural edge chipping / damage, or is deemed to not warrant full repair. Repair assumes cosmetic chip patching.			Cladding units damaged by impact at corners at column covers.					

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	none			
Damage State Probability:	0.50	0.50			

Fragility Parameters					
Median Demand, θ :	By User	By User			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	By User	By User			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	By User				
Data Relevance	By User				
Documentation Quality	By User				
Rationality	By User				
Consequence Functions					
Repair Description	By User, Repair cost assumed to equal 20% of DS2.		By User, Cost listed assumed the replacement of the panel		

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	8.33E+03	1.27E+04	1.42E+04	4.17E+04	6.34E+04	7.09E+04									
Best fit mean:	1.17E+04			5.86E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	2.00		8.00	2.00		8.00									
Average Repair Cost (Min Qty, Max Qty)	1.65E+04		1.01E+04	8.24E+04		5.07E+04									
CV or beta (Min Qty, Max Qty)	0.19		0.19	0.19		0.19									
Quantity Unit:	390 ft^2 Units			390 ft^2 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.22E+00	1.86E+00	2.08E+00	6.12E+00	9.32E+00	1.04E+01									
Best fit mean:	1.72E+00			8.62E+00											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	2.00		8.00	2.00		8.00									
Average Repair Time (Min Qty, Max Qty)	2.42E+00		1.49E+00	1.21E+01		7.46E+00									
CV or beta (Min Qty, Max Qty)	0.32		0.32	0.32		0.32									
Quantity Unit:	390 ft^2 Units			390 ft^2 Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										

Comments: Determine fragility story drift median demand in accordance with Chapter 7 of Volume 2.
Date Created: By User
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: By User
Revisions: 2016-06-27 Revise DS1 to be MutEx reduced cost version of itself.
Root Cost Multiplier: 390

FEMA P-58 Fragility Specification

NISTIR Classification B2011.201b
NISTIR Name Precast Concrete Panels 4.5 inches thick - out of plane deformation
Description Costing is based upon 30"x13" panels.

Line 296

Construction Quality: Not Specified

Seismic Installation Conditions: All

Fragility Unit of Measure: LF 30

Demand Parameter (unit): Peak Floor Acceleration g

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy Seq(DS1)

Descriptions Cladding units damaged by out of plane anchorage failure. Unit requires replacement.

Quantity Rounding Round Qty? NO

Allow sum by floor or building? NO

Demand Location (floor above?) No

Illustrations

none

1.00

Fragility Parameters

Median Demand, θ : By User

Data dispersion, β_d : Not Specified

Uncertainty, β_u : Not Specified

Total Dispersion, β : By User

Correlation (Yes / No) NO

Directionality (Yes / No) NO

Quality Ratings

Data Quality By User

Data Relevance By User

Documentation Quality By User

Rationality By User

Consequence Functions

Repair Description By User - Replace cladding panel.

Long Lead Time (Yes / No) NO

Repair Costs:

Repair Cost by Damage State: 4.17E+04 6.34E+04 7.09E+04

Best fit mean: 5.86E+04

Best Fit Distribution: Normal

Quantity Plateau (Min Qty, Max Qty) 2.00 8.00

Average Repair Cost (Min Qty, Max Qty) 8.24E+04 5.07E+04

CV or beta (Min Qty, Max Qty) 0.19 0.19

Quantity Unit: 390 ft^2 Units

Repair Time:

Repair Time by Damage State: 6.12E+00 9.32E+00 1.04E+01

Best fit mean: 9.32E+00

Best Fit Distribution: Normal

Quantity Plateau (Min Qty, Max Qty) 2.00 8.00

Average Repair Time (Min Qty, Max Qty) 1.21E+01 7.46E+00

CV or beta (Min Qty, Max Qty) 0.32 0.32

Quantity Unit: 390 ft^2 Units

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No) NO

Casualty-affected Planar Area (sf) per Normative Unit: Not Applicable

Serious Injury (Median, Dispersion) 0% 0.00

Loss of Life (Median, Dispersion) 0% 0.00

Post-event Tagging Flag: YES

Unsafe Placard Trigger (Median, Dispersion) 25% 0.50

Comments: Determine fragility peak floor acceleration anchorage capacity in accordance with Chapter 7 of Volume 2.

Date Created: By User

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: By User

Revisions: None

Root Cost Multiplier: 390

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2022.001
Curtain Walls - Generic Midrise Stick-Built Curtain wall, Config: Monolithic, Lamination: Unknown, Glass Type: Unknown, Details: Aspect ratio = 6:5, Other details Unknc
None

Line 297

Construction Quality: Not Specified

Seismic Installation Conditions: Not Specified

Fragility Unit of Measure: SF 30

Demand Parameter (unit): Story Drift Ratio Unit less

Number of Damage States: 2

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1,DS2)

Descriptions: Glass cracking.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO



No

DS2

Sequential

Glass falls from frame.

Illustrations



B2022.001a-DS1-1.JPGB2022.001a-DS2-1.JPG

Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

0.0338

0.0383

0.0797

0.19

0.25

0.25

0.4

0.4

NO

YES

Superior

Average

Superior

Superior

Replace cracked glass panel.

Replace cracked glass panel; cover exposure in meantime.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Each (5'x6' Panel)

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.37E+03

1.37E+03

2.00E+03

1.37E+03

1.37E+03

2.00E+03

1.55E+03

1.55E+03

20.00

20.00

100.00

20.00

20.00

100.00

2.06E+03

2.06E+03

1.10E+03

2.06E+03

2.06E+03

1.10E+03

0.17

0.17

0.17

0.17

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Each (5'x6' Panel)

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

6.03E-01

6.03E-01

8.82E-01

6.03E-01

6.03E-01

8.82E-01

6.03E-01

6.03E-01

20.00

20.00

100.00

20.00

20.00

100.00

9.05E-01

9.05E-01

4.82E-01

9.05E-01

9.05E-01

4.82E-01

0.30

0.30

0.30

0.30

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

NO

YES

Not Applicable

36 SF

0%

0%

0%

0%

0%

0%

None

By User

By User

By User

Not Given

2011-08-24 Negative probability below 0.5% drift - Overlap deemed acceptable.

Root Cost Multiplier: 30

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2022.002

Curtain Walls - Generic Midrise Stick-Built Curtain wall, Config: Insulating Glass Units (dual pane), Lamination: Unknown, Glass Type: Unknown, Details: Aspect ratio = 6:

None

Line 298

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

SF 30

Demand Parameter (unit):

Story Drift Ratio

Unit less

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Glass cracking.

Glass falls from frame.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations





B2022.001a-DS1-1.JPG

B2022.001a-DS2-1.JPG

Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.021

0.024

Data dispersion, β_d :

0.1663

0.16

Uncertainty, β_u :

0.25

0.25

Total Dispersion, β :

0.45

0.45

Correlation (Yes / No)

NO

Directionality (Yes / No)

YES

Quality Ratings

Data Quality

Superior

Data Relevance

Average

Documentation Quality

Superior

Rationality

Superior

Consequence Functions

Repair Description

Replace cracked glass panel.

Replace cracked glass panel; cover exposure in meantime.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

1.97E+03

1.97E+03

2.60E+03

1.97E+03

1.97E+03

2.60E+03

Best fit mean:

2.16E+03

2.16E+03

Best Fit Distribution:

LogNormal

LogNormal

Quantity Plateau (Min Qty, Max Qty)

20.00

100.00

20.00

100.00

Average Repair Cost (Min Qty, Max Qty)

2.96E+03

1.58E+03

2.96E+03

1.58E+03

CV or beta (Min Qty, Max Qty)

0.12

0.12

0.12

0.12

Quantity Unit:

Each (5'x6' Panel)

Each (5'x6' Panel)

Repair Time:

Repair Time by Damage State:

8.70E-01

8.70E-01

1.15E+00

8.70E-01

8.70E-01

1.15E+00

Best fit mean:

8.70E-01

8.70E-01

Best Fit Distribution:

LogNormal

LogNormal

Quantity Plateau (Min Qty, Max Qty)

20.00

100.00

20.00

100.00

Average Repair Time (Min Qty, Max Qty)

1.30E+00

6.96E-01

1.30E+00

6.96E-01

CV or beta (Min Qty, Max Qty)

0.28

0.28

0.28

0.28

Quantity Unit:

Each (5'x6' Panel)

Each (5'x6' Panel)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

NO

YES

Casualty-affected Planar Area (sf) per Normative Unit:

Not Applicable

36 SF

Serious Injury (Median, Dispersion)

0%

0.00

25%

0.50

Loss of Life (Median, Dispersion)

0%

0.00

0%

0.00

Post-event Tagging Flag:

NO

YES

Unsafe Placard Trigger (Median, Dispersion)

0%

0.00

50%

0.50

Comments:

None

Date Created:

By User

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

None

Root Cost Multiplier:

30

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2022.011

Midrise stick-built curtain wall, Config: Asymmetric insulating glass units (dual-pane, unequal-thickness IGU), Lamination: Laminated, Glass Type: Annealed, Details: 1/4 i

None

Line 299

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

SF 30

Story Drift Ratio

Unit less

3

DS1

Sequential

Seq(DS1,DS2,DS3)

Gasket seal failure.

DS2

Sequential

Glass cracking.

DS3

Sequential

Glass falls out.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO

No

No

Illustrations







B2022.003-DS1-1.JPG

B2022.001a-DS1-1.JPG

B2022.001a-DS2-1.JPG

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

0.026

0.1083

0.25

0.25

NO

YES

Superior

Average

Superior

Superior

Remove glass panel and replace damaged gaskets.

0.0268

0.14

0.25

0.25

Replace cracked glass panel.

0.0339

0.0973

0.25

0.25

Replace cracked glass panel; cover exposure in meantime.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.37E+03

1.37E+03

2.00E+03

1.97E+03

1.97E+03

2.60E+03

1.97E+03

1.97E+03

2.60E+03

1.55E+03

2.16E+03

2.16E+03

LogNormal

20.00

100.00

20.00

100.00

20.00

100.00

2.06E+03

1.10E+03

2.96E+03

1.58E+03

2.36E+03

1.67E+03

0.17

0.17

0.12

0.12

0.12

0.12

Each (5'x6' Panel)

Each (5'x6' Panel)

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

6.03E-01

6.03E-01

8.82E-01

8.70E-01

8.70E-01

1.15E+00

8.70E-01

8.70E-01

1.15E+00

6.03E-01

8.70E-01

8.70E-01

LogNormal

20.00

100.00

20.00

100.00

20.00

100.00

9.05E-01

4.82E-01

1.30E+00

6.96E-01

1.04E+00

7.40E-01

0.30

0.30

0.28

0.28

0.28

0.28

Each (5'x6' Panel)

Each (5'x6' Panel)

Each (5'x6' Panel)

NO

NO

YES

Not Applicable

Not Applicable

36 SF

0%

0.00

0%

0.00

25%

0.50

0%

0.00

0%

0.00

YES

0%

0.00

50%

0.50

None

By User

By User

By User

Not Given

2011-08-24 DS2 beta changed from 0.3 to 0.25 to avoid negative probabilities.

Root Cost Multiplier: 30

[illegible]

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2022.031

Midrise stick-built curtain wall, Config: Monolithic, Lamination: Not laminated, Glass Type: Annealed, Details: 1/4 in. (6 mm) AN monolithic; glass-frame clearance = 0.43

Line 303

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

SF 30

Story Drift Ratio

Unit less

2

DS1

Sequential

Seq(DS1,DS2)

Glass cracking.

DS2

Sequential

Glass falls from frame.

Quantity Rounding

Round Qty?

Allow sum by floor or building?


Demand Location (floor above?)

NO

NO

No

Illustrations





B2022.001a-DS1-1.JPG

B2022.001a-DS2-1.JPG

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.00

1.00

0.0138

0.0219

0.0797

0.19

0.25

0.25

0.25

0.3

NO

YES

Superior

Average

Superior

Superior

Replace cracked glass panel.

Replace cracked glass panel; cover exposure in meantime.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Time:

LifeSafety Hazard:

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.37E+03

1.37E+03

2.00E+03

1.37E+03

1.37E+03

2.00E+03

1.55E+03

1.55E+03

20.00

20.00

100.00

20.00

20.00

100.00

2.06E+03

2.06E+03

1.10E+03

2.06E+03

2.06E+03

1.10E+03

0.17

0.17

0.17

0.17

Each (5'x6' Panel)

Each (5'x6' Panel)

6.03E-01

6.03E-01

8.82E-01

6.03E-01

6.03E-01

8.82E-01

6.03E-01

6.03E-01

8.82E-01

20.00

20.00

100.00

20.00

20.00

100.00

9.05E-01

9.05E-01

4.82E-01

9.05E-01

9.05E-01

4.82E-01

0.30

0.30

0.30

0.30

Each (5'x6' Panel)

Each (5'x6' Panel)

NO

YES

Not Applicable

36 SF

0%

0%

0.00

25%

0%

0%

0.00

0.50

0.00

NO

YES

0%

50%

0.00

0.50

None

By User

By User

By User

Not Given

2011-08-24 Negative probability below 0.5% drift - Overlap deemed acceptable.

Root Cost Multiplier: 30

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2022.032

Midrise stick-built curtain wall, Config: Monolithic, Lamination: Not laminated, Glass Type: Annealed, Details: 1/4 in. (6 mm) AN monolithic; glass-frame clearance = 0 in.

Line 304

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

SF 30

Story Drift Ratio

Unit less

2

DS1

Sequential

Seq(DS1,DS2)

Glass cracking.

DS2

Sequential

Glass falls from frame.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO

No

Illustrations





B2022.001a-DS1-1.JPG

B2022.001a-DS2-1.JPG

Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

0.0088

0.0321

0.25

0.25

NO

YES

Superior

Average

Superior

Superior

Replace cracked glass panel.

Replace cracked glass panel; cover exposure in meantime.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.37E+03

1.37E+03

2.00E+03

1.37E+03

1.37E+03

2.00E+03

1.55E+03

1.55E+03

20.00

20.00

100.00

20.00

20.00

100.00

2.06E+03

2.06E+03

1.10E+03

2.06E+03

2.06E+03

1.10E+03

0.17

0.17

0.17

Each (5'x6' Panel)

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

6.03E-01

6.03E-01

8.82E-01

6.03E-01

6.03E-01

8.82E-01

6.03E-01

6.03E-01

20.00

20.00

100.00

20.00

20.00

100.00

9.05E-01

9.05E-01

4.82E-01

9.05E-01

9.05E-01

4.82E-01

0.30

0.30

0.30

Each (5'x6' Panel)

Each (5'x6' Panel)

NO

YES

Not Applicable

36 SF

0%

0%

0%

0%

0.00

0.00

0.00

0.00

0.00

0.00

25%

25%

50%

50%

None

By User

By User

By User

Not Given

None

Root Cost Multiplier:

30

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2022.033

Midrise stick-built curtain wall, Config: Monolithic, Lamination: Not laminated, Glass Type: Annealed, Details: 1/4 in. (6 mm) AN monolithic; glass-frame clearance = 0.13

Line 305

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

SF 30

Demand Parameter (unit):

Story Drift Ratio

Unit less

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Glass cracking.

Glass falls from frame.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations





B2022.001a-DS1-1.JPG

B2022.001a-DS2-1.JPG

Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.0084

0.0107

Data dispersion, β_d :

0.0757

0.26

Uncertainty, β_u :

0.25

0.25

Total Dispersion, β :

0.25

0.35

Correlation (Yes / No)

NO

Directionality (Yes / No)

YES

Quality Ratings

Data Quality

Superior

Data Relevance

Average

Documentation Quality

Superior

Rationality

Superior

Consequence Functions

Repair Description

Replace cracked glass panel.

Replace cracked glass panel; cover exposure in meantime.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

1.97E+03

1.97E+03

2.60E+03

1.97E+03

1.97E+03

2.60E+03

Best fit mean:

2.16E+03

2.16E+03

Best Fit Distribution:

LogNormal

LogNormal

Quantity Plateau (Min Qty, Max Qty)

20.00

100.00

20.00

100.00

Average Repair Cost (Min Qty, Max Qty)

2.96E+03

1.58E+03

2.96E+03

1.58E+03

CV or beta (Min Qty, Max Qty)

0.12

0.12

0.12

0.12

Quantity Unit:

Each (5'x6' Panel)

Each (5'x6' Panel)

Repair Time:

Repair Time by Damage State:

8.70E-01

8.70E-01

1.15E+00

8.70E-01

8.70E-01

1.15E+00

Best fit mean:

8.70E-01

8.70E-01

Best Fit Distribution:

LogNormal

LogNormal

Quantity Plateau (Min Qty, Max Qty)

20.00

100.00

20.00

100.00

Average Repair Time (Min Qty, Max Qty)

1.30E+00

6.96E-01

1.30E+00

6.96E-01

CV or beta (Min Qty, Max Qty)

0.28

0.28

0.28

0.28

Quantity Unit:

Each (5'x6' Panel)

Each (5'x6' Panel)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

NO

YES

Casualty-affected Planar Area (sf) per Normative Unit:

Not Applicable

36 SF

Serious Injury (Median, Dispersion)

0%

0.00

25%

0.50

Loss of Life (Median, Dispersion)

0%

0.00

0%

0.00

Post-event Tagging Flag:

NO

YES

Unsafe Placard Trigger (Median, Dispersion)

0%

0.00

50%

0.50

Comments:

None

Date Created:

By User

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2011-08-24 Negative probability below 0.5% drift - Overlap deemed acceptable.

Root Cost Multiplier:

30

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2022.034

Midrise stick-built curtain wall, Config: Monolithic, Lamination: Not laminated, Glass Type: Annealed, Details: 1/4 in. (6 mm) AN monolithic; glass-frame clearance = 0.25

Line 306

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

SF 30

Story Drift Ratio

2

DS1

Sequential

Seq(DS1,DS2)

Glass cracking.

Not Specified

DS2

Sequential

Glass falls from frame.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO

No

Illustrations





B2022.001a-DS1-1.JPG

B2022.001a-DS2-1.JPG

Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

0.0147

0.0164

NO

YES

Superior

Average

Superior

Superior

Replace cracked glass panel.

Replace cracked glass panel; cover exposure in meantime.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.97E+03

1.97E+03

2.60E+03

1.97E+03

1.97E+03

2.60E+03

2.16E+03

LogNormal

20.00

100.00

2.96E+03

1.58E+03

0.12

0.12

Each (5'x6' Panel)

8.70E-01

8.70E-01

1.15E+00

8.70E-01

8.70E-01

1.15E+00

8.70E-01

LogNormal

20.00

100.00

1.30E+00

6.96E-01

0.28

0.28

Each (5'x6' Panel)

NO

YES

Not Applicable

36 SF

0%

0.00

25%

0.50

0%

0.00

0%

0.00

50%

0.50

None

By User

By User

By User

Not Given

None

Root Cost Multiplier:

30

[illegible]

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2022.037

Midrise stick-built curtain wall, Config: Monolithic, Lamination: Not laminated, Glass Type: Annealed, Details: 1/4 in. (6 mm) AN monolithic, 2-sided SSG, Center Panel; g

None

Line 309

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

SF 30

Story Drift Ratio

2

DS1

Sequential

Seq(DS1,DS2)

Glass cracking.

Not Specified

Unit less

DS2

Sequential

Glass falls from frame.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO

No

Illustrations

none

none

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.00

1.00

By User

Not Specified

Not Specified

By User

NO

YES

Not Rated

Not Rated

Not Rated

Not Rated

Replace cracked glass panel.

Replace cracked glass panel; cover exposure in meantime.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.97E+03

1.97E+03

2.60E+03

1.97E+03

1.97E+03

2.60E+03

2.16E+03

LogNormal

20.00

100.00

2.96E+03

1.58E+03

0.12

0.12

Each (5'x6' Panel)

8.70E-01

8.70E-01

1.15E+00

8.70E-01

8.70E-01

1.15E+00

8.70E-01

LogNormal

20.00

100.00

1.30E+00

6.96E-01

0.28

0.28

Each (5'x6' Panel)

NO

YES

Not Applicable

36 SF

0%

0.00

25%

0.50

0%

0.00

0%

0.00

50%

0.50

confirm damage state, repair, lead time, and casualty data. This component requires user specified cost and time consequence data. Values within PACT are defaults

Root Cost Multiplier:

30

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2022.038

Midrise stick-built curtain wall, Config: Monolithic, Lamination: Not laminated, Glass Type: Annealed, Details: 1/4 in. (6 mm) AN monolithic, 2-sided SSG, Outside Panel; 1

None

Line 310

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

SF 30

Demand Parameter (unit):

Story Drift Ratio

Unit less

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Glass cracking.

Glass falls from frame.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

none

none

Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User

Not Specified

Not Specified

By User

NO

YES

Not Rated

Not Rated

Not Rated

Not Rated

Replace cracked glass panel.

Replace cracked glass panel; cover exposure in meantime.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.97E+03

1.97E+03

2.60E+03

1.97E+03

1.97E+03

2.60E+03

2.16E+03

LogNormal

20.00

100.00

2.96E+03

1.58E+03

0.12

0.12

Each (5'x6' Panel)

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

8.70E-01

8.70E-01

1.15E+00

8.70E-01

8.70E-01

1.15E+00

8.70E-01

LogNormal

20.00

100.00

1.30E+00

6.96E-01

0.28

0.28

Each (5'x6' Panel)

Each (5'x6' Panel)

NO

YES

Not Applicable

36 SF

0%

0.00

25%

0.50

0%

0.00

0%

0.00

50%

0.50

confirm damage state, repair, lead time, and casualty data. This component requires user specified cost and time consequence data. Values within PACT are defaults

Root Cost Multiplier:

30

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2022.039

Midrise stick-built curtain wall, Config: Monolithic, Lamination: Not laminated, Glass Type: Annealed, Details: 1/4 in. (6 mm) AN monolithic; glass-frame clearance = 0.43

Line 311

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

SF 30

Demand Parameter (unit):

Story Drift Ratio

Unit less

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Glass cracking.

Glass falls from frame.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

2.16E+03

By User

Data dispersion, β_d :

Not Specified

Not Specified

Uncertainty, β_u :

Not Specified

Not Specified

Total Dispersion, β :

By User

By User

Correlation (Yes / No)

NO

Directionality (Yes / No)

YES

Quality Ratings

Data Quality

Not Rated

Data Relevance

Not Rated

Documentation Quality

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Replace cracked glass panel.

Replace cracked glass panel; cover exposure in meantime.

Long Lead Time (Yes / No) NO NO

Repair Costs:

Repair Cost by Damage State:

1.97E+03

1.97E+03

2.60E+03

1.97E+03

1.97E+03

2.60E+03

Best fit mean:

2.16E+03

2.16E+03

Best Fit Distribution:

LogNormal

LogNormal

Quantity Plateau (Min Qty, Max Qty)

20.00

100.00

20.00

100.00

Average Repair Cost (Min Qty, Max Qty)

2.96E+03

1.58E+03

2.96E+03

1.58E+03

CV or beta (Min Qty, Max Qty)

0.12

0.12

0.12

0.12

Quantity Unit:

Each (5'x6' Panel)

Each (5'x6' Panel)

Repair Time:

Repair Time by Damage State:

8.70E-01

8.70E-01

1.15E+00

8.70E-01

8.70E-01

1.15E+00

Best fit mean:

8.70E-01

8.70E-01

Best Fit Distribution:

LogNormal

LogNormal

Quantity Plateau (Min Qty, Max Qty)

20.00

100.00

20.00

100.00

Average Repair Time (Min Qty, Max Qty)

1.30E+00

6.96E-01

1.30E+00

6.96E-01

CV or beta (Min Qty, Max Qty)

0.28

0.28

0.28

0.28

Quantity Unit:

Each (5'x6' Panel)

Each (5'x6' Panel)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

NO

YES

Casualty-affected Planar Area (sf) per Normative Unit:

Not Applicable

36 SF

Serious Injury (Median, Dispersion)

0%

0.00

25%

0.50

Loss of Life (Median, Dispersion)

0%

0.00

0%

0.00

Post-event Tagging Flag:

NO

YES

Unsafe Placard Trigger (Median, Dispersion)

0%

0.00

50%

0.50

Comments:

confirm damage state, repair, lead time, and casualty data. This component requires user specified cost and time consequence data. Values within PACT are defaults

Date Created:

By User

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

By User

Revisions:

None

Root Cost Multiplier:

30

Comments:	confirm damage state, repair, lead time, and casualty data. This component requires user specified cost and time consequence data. Values within PACT are defaults	
Date Created:	By User	Root Cost Multiplier: 30
Approved (YES / NO)?	By User	
Official (YES / NO) ?	By User	
Author:	By User	
Revisions:	None	

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2022.041

Midrise stick-built curtain wall, Config: Monolithic, Lamination: Not laminated, Glass Type: Annealed, Details: 1/4 in. (6 mm) AN monolithic; glass-frame clearance = 0.43

Line 313

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

SF 30

Story Drift Ratio

2

DS1

Sequential

Seq(DS1,DS2)

Glass cracking.

Not Specified

Unit less

DS2

Sequential

Glass falls from frame.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO

No

Illustrations

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

none

1.00

By User

Not Specified

Not Specified

By User

NO

YES

Not Rated

Not Rated

Not Rated

Not Rated

Replace cracked glass panel.

none

1.00

By User

Not Specified

Not Specified

By User

NO

YES

Not Rated

Not Rated

Not Rated

Replace cracked glass panel; cover exposure in meantime.

Long Lead Time (Yes / No)NO

Repair Costs:

Repair Time:

LifeSafety Hazard:

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.97E+03

1.97E+03

2.60E+03

1.97E+03

1.97E+03

2.60E+03

2.16E+03

LogNormal

20.00

100.00

2.96E+03

1.58E+03

0.12

0.12

Each (5'x6' Panel)

Each (5'x6' Panel)

8.70E-01

8.70E-01

1.15E+00

8.70E-01

8.70E-01

1.15E+00

8.70E-01

LogNormal

20.00

100.00

1.30E+00

6.96E-01

0.28

0.28

Each (5'x6' Panel)

Each (5'x6' Panel)

NO

YES

Not Applicable

36 SF

0%

0.00

25%

0.50

0%

0.00

0%

0.00

50%

0.50

confirm damage state, repair, lead time, and casualty data. This component requires user specified cost and time consequence data. Values within PACT are defaults

By User

By User

By User

By User

None

Root Cost Multiplier:

30

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2022.051

Midrise stick-built curtain wall, Config: Monolithic, Lamination: Not laminated, Glass Type: Full tempered, Details: 1/4 in. (6 mm) FT monolithic, 2-sided SSG, Center Pane

Line 314

None

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

SF 30

Story Drift Ratio

2

DS1

Sequential

Seq(DS1,DS2)

Glass cracking.

Not Specified

Unit less

DS2

Sequential

Glass falls from frame.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO

No

Illustrations

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

none

1.00

By User

Not Specified

Not Specified

By User

NO

YES

Not Rated

Not Rated

Not Rated

Not Rated

Replace cracked glass panel.

none

1.00

By User

Not Specified

Not Specified

By User

NO

YES

Not Rated

Not Rated

Not Rated

Replace cracked glass panel; cover exposure in meantime.

Long Lead Time (Yes / No)

NO NO

Repair Costs:

Repair Time:

LifeSafety Hazard:

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.97E+03

1.97E+03

2.60E+03

1.97E+03

1.97E+03

2.60E+03

2.16E+03

LogNormal

20.00

100.00

2.96E+03

1.58E+03

0.12

0.12

Each (5'x6' Panel)

Each (5'x6' Panel)

8.70E-01

8.70E-01

1.15E+00

8.70E-01

8.70E-01

1.15E+00

8.70E-01

LogNormal

20.00

100.00

1.30E+00

6.96E-01

0.28

0.28

Each (5'x6' Panel)

Each (5'x6' Panel)

NO

YES

Not Applicable

36 SF

0%

0.00

25%

0.50

0%

0.00

0%

0.00

50%

0.50

confirm damage state, repair, lead time, and casualty data. This component requires user specified cost and time consequence data. Values within PACT are defaults

By User

By User

By User

By User

None

Root Cost Multiplier:

30

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2022.052

Midrise stick-built curtain wall, Config: Monolithic, Lamination: Not laminated, Glass Type: Full tempered, Details: 1/4 in. (6 mm) FT monolithic, 2-sided SSG, Outside Pan

Line 315

None

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

SF 30

Story Drift Ratio

2

DS1

Sequential

Seq(DS1,DS2)

Glass cracking.

Not Specified

Unit less

DS2

Sequential

Glass falls from frame.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO

No

Illustrations

none

none

1.00

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User

Not Specified

Not Specified

By User

NO

YES

Not Rated

Not Rated

Not Rated

Not Rated

Replace cracked glass panel.

By User

Not Specified

Not Specified

By User

Replace cracked glass panel; cover exposure in meantime.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.97E+03

1.97E+03

2.60E+03

1.97E+03

1.97E+03

2.60E+03

2.16E+03

LogNormal

20.00

100.00

2.96E+03

1.58E+03

0.12

0.12

Each (5'x6' Panel)

8.70E-01

8.70E-01

1.15E+00

8.70E-01

8.70E-01

1.15E+00

8.70E-01

LogNormal

20.00

100.00

1.30E+00

6.96E-01

0.28

0.28

Each (5'x6' Panel)

NO

YES

Not Applicable

36 SF

0%

0.00

25%

0.50

0%

0.00

0%

0.00

50%

0.50

confirm damage state, repair, lead time, and casualty data. This component requires user specified cost and time consequence data. Values within PACT are defaults

By User

By User

By User

By User

None

Root Cost Multiplier:

30

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2022.054

Midrise stick-built curtain wall, Config: Monolithic, Lamination: Not laminated, Glass Type: Full tempered, Details: 1/4 in. (6 mm) FT monolithic, Polished Edge; glass-fran

None

Line 317

Construction Quality:

Not Specified

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

SF 30

Demand Parameter (unit):

Story Drift Ratio

Unit less

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2)

Descriptions

Glass cracking.

Glass falls from frame.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User

Not Specified

Not Specified

By User

NO

YES

Not Rated

Not Rated

Not Rated

Not Rated

Replace cracked glass panel.

Replace cracked glass panel; cover exposure in meantime.

Long Lead Time (Yes / No) NO NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.97E+03

1.97E+03

2.60E+03

1.97E+03

1.97E+03

2.60E+03

2.16E+03

LogNormal

20.00

100.00

2.96E+03

1.58E+03

0.12

0.12

Each (5'x6' Panel)

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

8.70E-01

8.70E-01

1.15E+00

8.70E-01

8.70E-01

1.15E+00

8.70E-01

LogNormal

20.00

100.00

1.30E+00

6.96E-01

0.28

0.28

Each (5'x6' Panel)

Each (5'x6' Panel)

NO

YES

Not Applicable

36 SF

0%

0.00

25%

0.50

0%

0.00

0%

0.00

50%

0.50

confirm damage state, repair, lead time, and casualty data. This component requires user specified cost and time consequence data. Values within PACT are defaults

Root Cost Multiplier:

30

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2022.061
Midrise stick-built curtain wall, Config: Monolithic, Lamination: Not laminated, Glass Type: Heat strengthened, Details: 1/4 in. (6 mm) HS monolithic; glass-frame clearan
None

Line 318

Construction Quality: Not Specified

Seismic Installation Conditions: Not Specified

Fragility Unit of Measure: SF 30

Demand Parameter (unit): Story Drift Ratio Unit less

Number of Damage States: 2

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1,DS2)

Descriptions: Glass cracking.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO

No

DS2

Sequential

Glass falls from frame.

Illustrations

Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User

Not Specified

Not Specified

By User

NO

YES

Not Rated

Not Rated

Not Rated

Not Rated

Replace cracked glass panel.

By User

Not Specified

Not Specified

By User

Replace cracked glass panel; cover exposure in meantime.

Long Lead Time (Yes / No) NO NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.97E+03

1.97E+03

2.60E+03

1.97E+03

1.97E+03

2.60E+03

2.16E+03

LogNormal

20.00

100.00

2.96E+03

1.58E+03

0.12

0.12

Each (5'x6' Panel)

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

8.70E-01

8.70E-01

1.15E+00

8.70E-01

8.70E-01

1.15E+00

8.70E-01

LogNormal

20.00

100.00

1.30E+00

6.96E-01

0.28

0.28

Each (5'x6' Panel)

Each (5'x6' Panel)

NO

YES

Not Applicable

36 SF

0%

0.00

25%

0.50

0%

0.00

0%

0.00

50%

0.50

confirm damage state, repair, lead time, and casualty data. This component requires user specified cost and time consequence data. Values within PACT are defaults

By User

By User

By User

By User

None

Root Cost Multiplier:

30

Dispersal(s):	0%	0.00	0%	0.00	30%	0.30		
Comments:	None							
Date Created:	By User							Root Cost Multiplier: 30
Approved (YES / NO)?	By User							
Official (YES / NO) ?	By User							
Author:	Not Given							
Revisions:	None							

Root Cost Multiplier: 30

Dispersion:	0%	0.00	30%	0.30					
Comments:	None								
Date Created:	By User						Root Cost Multiplier: 30		
Approved (YES / NO)?	By User								
Official (YES / NO) ?	By User								
Author:	Not Given								
Revisions:	None								

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2022.083

Midrise stick-built curtain wall, Config: Symmetric insulating glass units (dual-pane, equal-thickness IGU), Lamination: Not laminated, Glass Type: Annealed, Details: 1 in.

None

Line 323

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

SF 30

Story Drift Ratio

Unit less

3

DS1

Sequential

Seq(DS1,DS2,DS3)

Gasket seal failure.

DS2

Sequential

Glass cracking.

DS3

Sequential

Glass falls out.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO

No

Illustrations

none

1.00

1.00

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

NO

YES

Not Rated

Not Rated

Not Rated

Not Rated

Remove glass panel and replace damaged gaskets.

Replace cracked glass panel.

Replace cracked glass panel; cover exposure in meantime.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
1.37E+03	1.37E+03	2.00E+03	1.97E+03	1.97E+03	2.60E+03	1.97E+03	1.97E+03	2.60E+03						
1.55E+03			2.16E+03			2.16E+03								
LogNormal			LogNormal			LogNormal								
20.00			100.00			100.00								
2.06E+03			1.10E+03			2.96E+03			1.58E+03			2.36E+03		
0.17			0.17			0.12			0.12			0.12		
Each (5'x6' Panel)			Each (5'x6' Panel)			Each (5'x6' Panel)								
P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
6.03E-01	6.03E-01	8.82E-01	8.70E-01	8.70E-01	1.15E+00	8.70E-01	8.70E-01	1.15E+00						
6.03E-01			8.70E-01			8.70E-01								
LogNormal			LogNormal			LogNormal								
20.00			100.00			100.00								
9.05E-01			4.82E-01			1.30E+00			6.96E-01			1.04E+00		
0.30			0.30			0.28			0.28			0.28		
Each (5'x6' Panel)			Each (5'x6' Panel)			Each (5'x6' Panel)								
NO			NO			YES								
Not Applicable			Not Applicable			36 SF								
0%			0.00			0%			0.00			25%		
0%			0.00			0%			0.00			0%		
NO			NO			YES								
0%			0.00			0%			0.00			50%		

confirm damage state, repair, lead time, and casualty data. This component requires user specified cost and time consequence data. Values within PACT are defaults

By User

By User

By User

By User

None

Root Cost Multiplier:

30

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2022.101
Midrise stick-built curtain wall, Config: Symmetric insulating glass units (dual-pane, equal-thickness IGU), Lamination: Not laminated, Glass Type: Heat strengthened, Det
None

Line 326

Construction Quality: Not Specified

Seismic Installation Conditions: Not Specified

Fragility Unit of Measure: SF 30

Demand Parameter (unit): Story Drift Ratio Unit less

Number of Damage States: 3

Damage State: DS1DS2DS3

Type of Damage State: SequentialSequentialSequential

DS Hierarchy: Seq(DS1,DS2,DS3)

Descriptions: Gasket seal failure. Glass cracking. Glass falls out.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO

No

Illustrations

none

1.00

1.00

1.00

Damage State Probability:

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User

Not Specified

Not Specified

By User

NO

YES

Not Rated

Not Rated

Not Rated

Not Rated

Remove glass panel and replace damaged gaskets.

Replace cracked glass panel.

Replace cracked glass panel; cover exposure in meantime.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.37E+03

1.37E+03

2.00E+03

1.97E+03

1.97E+03

2.60E+03

1.97E+03

1.97E+03

2.60E+03

1.55E+03

LogNormal

20.00

100.00

2.06E+03

0.17

1.10E+03

0.17

2.96E+03

0.12

1.58E+03

0.12

2.36E+03

0.12

1.67E+03

0.12

Each (5'x6' Panel)

Each (5'x6' Panel)

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

6.03E-01

6.03E-01

8.82E-01

8.70E-01

8.70E-01

1.15E+00

8.70E-01

8.70E-01

1.15E+00

8.70E-01

LogNormal

20.00

100.00

20.00

100.00

20.00

100.00

9.05E-01

0.30

4.82E-01

0.30

1.30E+00

0.28

6.96E-01

0.28

1.04E+00

0.28

7.40E-01

0.28

Each (5'x6' Panel)

Each (5'x6' Panel)

Each (5'x6' Panel)

NO

NO

YES

Not Applicable

Not Applicable

36 SF

0%

0.00

0%

0.00

25%

0.50

0%

0.00

0%

0.00

NO

NO

YES

0%

0.00

0%

0.00

50%

0.50

confirm damage state, repair, lead time, and casualty data.

By User

By User

By User

By User

None

Root Cost Multiplier:

30

Dispersion:	0%	0.00	0%	0.00	50%	0.50
Comments:	confirm damage state, repair, lead time, and casualty data. This component requires user specified cost and time consequence data. Values within PACT are defaults					
Date Created:	By User	Root Cost Multiplier: 30				
Approved (YES / NO)?	By User					
Official (YES / NO) ?	By User					
Author:	By User					
Revisions:	None					

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2023.011
Storefront, Config: Monolithic, Lamination: Laminated, Glass Type: Annealed, Details: 1/4 in. (6 mm) AN LAM (0.030 PVB); glass-frame clearance = 0.41 in. (10 mm); aspe
None

Line 330

Construction Quality: Not Specified

Seismic Installation Conditions: Not Specified

Fragility Unit of Measure: SF 30

Demand Parameter (unit): Story Drift Ratio Unit less

Number of Damage States: 3

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1,DS2,DS3)

Descriptions: Gasket seal failure.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

No

No

DS2

DS3

Sequential

Sequential

Glass cracking.

Glass falls out.

Illustrations







B2022.003-DS1-1.JPGB2022.001a-DS1-1.JPGB2022.001a-DS2-1.JPG

Damage State Probability:

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

0.029

0.0567

0.08

0.4492

0.14

0.99

0.25

0.25

0.25

0.5

0.3

0.3

NO

YES

Superior

Average

Superior

Superior

Remove glass panel and replace damaged gaskets.

Replace cracked glass panel.

Replace cracked glass panel; cover exposure in meantime.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

7.70E+02

7.70E+02

1.40E+03

1.37E+03

1.37E+03

2.00E+03

1.37E+03

1.37E+03

2.00E+03

9.35E+02

1.55E+03

1.55E+03

LogNormal

LogNormal

LogNormal

44.00

434.00

44.00

434.00

44.00

434.00

9.24E+02

5.39E+02

0.00E+00

0.00E+00

0.00E+00

0.00E+00

0.28

0.28

0.17

0.17

0.17

0.17

Each (5'x6' Panel)

Each (5'x6' Panel)

Each (5'x6' Panel)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

5.70E-01

5.70E-01

1.02E+00

1.02E+00

1.02E+00

1.47E+00

1.02E+00

1.02E+00

1.47E+00

5.70E-01

1.02E+00

1.02E+00

LogNormal

LogNormal

LogNormal

44.00

434.00

44.00

434.00

44.00

434.00

6.83E-01

4.00E-01

1.02E+00

1.02E+00

1.02E+00

1.02E+00

0.38

0.38

0.30

0.30

0.30

0.30

Each (5'x6' Panel)

Each (5'x6' Panel)

Each (5'x6' Panel)

NO

NO

YES

Not Applicable

Not Applicable

36 SF

0%

0.00

0%

0.00

25%

0.50

0%

0.00

0%

0.00

0%

0.00

NO

NO

YES

0%

0.00

0%

0.00

50%

0.50

None

By User

By User

By User

Not Given

2011-08-24 DS3 beta changed from 1 to 0.3 to avoid negative probabilities.

Root Cost Multiplier:

30

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2023.021

Storefront, Config: Monolithic, Lamination: Not laminated, Glass Type: Annealed, Details: 1/4 in. (6 mm) AN monolithic; glass-frame clearance = 0.41 in. (10 mm); aspect

Line 331

None

Construction Quality:	Not Specified				<div>Quantity Rounding</div> <div>Round Qty?</div> <div>NO</div> <div>Allow sum by floor or building?</div> <div>NO</div> <div>Demand Location (floor above?)</div> <div>No</div>
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	SF 30				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Gasket seal failure.		Glass cracking.		Glass falls out.

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	No	
Demand Location (floor above?)	No	

Illustrations					
	B2022.003-DS1-1.JPG	B2022.001a-DS1-1.JPG	B2022.001a-DS2-1.JPG		

Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.0303	0.0413	0.051		
Data dispersion, β_d :	0.424	0.13	0.147		
Uncertainty, β_u :	0.25	0.25	0.25		
Total Dispersion, β :	0.5	0.3	0.3		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Superior				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Remove glass panel and replace damaged gaskets.	Replace cracked glass panel.	Replace cracked glass panel; cover exposure in meantime.		

Long Lead Time (Yes / No)	NO			NO			NO									
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	
Repair Cost by Damage State:	7.70E+02	7.70E+02	1.40E+03	1.37E+03	1.37E+03	2.00E+03	1.37E+03	1.37E+03	2.00E+03							
Best fit mean:	9.35E+02			1.55E+03			1.55E+03									
Best Fit Distribution:	LogNormal			LogNormal			LogNormal									
Quantity Plateau (Min Qty, Max Qty)	44.00		434.00	44.00		434.00	44.00		434.00							
Average Repair Cost (Min Qty, Max Qty)	9.24E+02		5.39E+02	0.00E+00		0.00E+00	0.00E+00		0.00E+00							
CV or beta (Min Qty, Max Qty)	0.28		0.28	0.17		0.17	0.17		0.17							
Quantity Unit:	Each (5'x6' Panel)			Each (5'x6' Panel)			Each (5'x6' Panel)									
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	
Repair Time by Damage State:	5.70E-01	5.70E-01	1.02E+00	1.02E+00	1.02E+00	1.47E+00	1.02E+00	1.02E+00	1.47E+00							
Best fit mean:	5.70E-01			1.02E+00			1.02E+00									
Best Fit Distribution:	LogNormal			LogNormal			LogNormal									
Quantity Plateau (Min Qty, Max Qty)	44.00		434.00	44.00		434.00	44.00		434.00							
Average Repair Time (Min Qty, Max Qty)	6.83E-01		4.00E-01	1.02E+00		1.02E+00	1.02E+00		1.02E+00							
CV or beta (Min Qty, Max Qty)	0.38		0.38	0.30		0.30	0.30		0.30							
Quantity Unit:	Each (5'x6' Panel)			Each (5'x6' Panel)			Each (5'x6' Panel)									
LifeSafety Hazard:																
Potential non-collapse casualties? (Yes / No)	NO			NO			YES									
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			36 SF									
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		25%	0.50								
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00								
Post-event Tagging Flag:	NO			NO			YES									
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		50%	0.50								
Comments:	None															
Date Created:	By User															
Approved (YES / NO)?	By User															
Official (YES / NO) ?	By User															
Author:	Not Given															
Revisions:	2011-08-24 Negative probability deemed acceptable.															
											Root Cost Multiplier:	30				

Root Cost Multiplier: 30

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2023.031

Storefront, Config: Monolithic, Lamination: Not laminated, Glass Type: Full tempered, Details: 3/8 in. (10 mm) FT monolithic, Planar Specimen; glass-frame clearance = 0

Line 332

None

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

SF 30

Story Drift Ratio

1

DS1

Sequential

Seq(DS1)

Damage State by User

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO

No

Illustrations

none

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User

Not Specified

Not Specified

By User

NO

YES

Not Rated

Not Rated

Not Rated

Not Rated

Repair by User

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER	BY USER												
Best Fit Distribution:	BY USER	BY USER	BY USER												
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER	BY USER												
Average Repair Cost (Min Qty, Max Qty)	BY USER	BY USER	BY USER												
CV or beta (Min Qty, Max Qty)	BY USER	BY USER	BY USER												
Quantity Unit:	BY USER	BY USER	BY USER												
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER	BY USER												
Best Fit Distribution:	BY USER	BY USER	BY USER												
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER	BY USER												
Average Repair Time (Min Qty, Max Qty)	BY USER	BY USER	BY USER												
CV or beta (Min Qty, Max Qty)	BY USER	BY USER	BY USER												
Quantity Unit:	BY USER	BY USER	BY USER												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	confirm damage state, repair, lead time, and casualty data. This component requires user specified cost and time consequence data. Values within PACT are defaults														
Date Created:	By User														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	By User														
Revisions:	None														

Root Cost Multiplier: 1

Revisions: None

Date Created:	By User
Approved (YES / NO)?	By User
Official (YES / NO) ?	By User
Author:	By User
Revisions:	None

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2023.034

Storefront, Config: Monolithic, Lamination: Not laminated, Glass Type: Full tempered, Details: 3/8 in. (10 mm) FT monolithic, Corner Cond. Specimen, Short side; glass-fr

Line 335

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Not Specified

Not Specified

SF 30

Story Drift Ratio

1

DS1

Sequential

Seq(DS1)

Damage State by User

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO

No

Illustrations

Damage State Probability:

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User

Not Specified

Not Specified

By User

NO

YES

Not Rated

Not Rated

Not Rated

Not Rated

Repair by User

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER	BY USER												
Best Fit Distribution:	BY USER	BY USER	BY USER												
Quantity Plateau (Min Qty, Max Qty)	BY USER		BY USER												
Average Repair Cost (Min Qty, Max Qty)	BY USER		BY USER												
CV or beta (Min Qty, Max Qty)	BY USER		BY USER												
Quantity Unit:	BY USER														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER	BY USER												
Best Fit Distribution:	BY USER	BY USER	BY USER												
Quantity Plateau (Min Qty, Max Qty)	BY USER		BY USER												
Average Repair Time (Min Qty, Max Qty)	BY USER		BY USER												
CV or beta (Min Qty, Max Qty)	BY USER		BY USER												
Quantity Unit:	BY USER														
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)		NO													
Casualty-affected Planar Area (sf) per Normative Unit:		Not Applicable													
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:		NO													
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	confirm damage state, repair, lead time, and casualty data. This component requires user specified cost and time consequence data. Values within PACT are defaults														
Date Created:	By User														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	By User														
Revisions:	None														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2023.052
Storefront, Config: Symmetric insulating glass units (dual-pane, equal-thickness IGU), Lamination: Not laminated, Glass Type: Full tempered, Details: 1 in. (25 mm) FT IGL
None

Line 338

Construction Quality: Not Specified

Seismic Installation Conditions: Not Specified

Fragility Unit of Measure: SF 30

Demand Parameter (unit): Story Drift RatioUnit less

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1)

Descriptions: Damage State by User

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

none

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User
Not Specified
Not Specified
By User
NO
YES
Not Rated
Not Rated
Not Rated
Not Rated
Repair by User

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER	BY USER												
Best Fit Distribution:	BY USER	BY USER	BY USER												
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER	BY USER												
Average Repair Cost (Min Qty, Max Qty)	BY USER	BY USER	BY USER												
CV or beta (Min Qty, Max Qty)	BY USER	BY USER	BY USER												
Quantity Unit:	BY USER	BY USER	BY USER												
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER	BY USER												
Best Fit Distribution:	BY USER	BY USER	BY USER												
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER	BY USER												
Average Repair Time (Min Qty, Max Qty)	BY USER	BY USER	BY USER												
CV or beta (Min Qty, Max Qty)	BY USER	BY USER	BY USER												
Quantity Unit:	BY USER	BY USER	BY USER												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	confirm damage state, repair, lead time, and casualty data. This component requires user specified cost and time consequence data. Values within PACT are defaults														
Date Created:	By User														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	By User														
Revisions:	None														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2023.053
Storefront, Config: Symmetric insulating glass units (dual-pane, equal-thickness IGU), Lamination: Not laminated, Glass Type: Full tempered, Details: 1 in. (25 mm) FT IGL
None

Line 339

Construction Quality: Not Specified

Seismic Installation Conditions: Not Specified

Fragility Unit of Measure: SF 30

Demand Parameter (unit): Story Drift Ratio Unit less

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1)

Descriptions: Damage State by User

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Illustrations

none

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User
Not Specified
Not Specified
By User
NO
YES
Not Rated
Not Rated
Not Rated
Not Rated
Repair by User

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER	BY USER												
Best Fit Distribution:	BY USER	BY USER	BY USER												
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER	BY USER												
Average Repair Cost (Min Qty, Max Qty)	BY USER	BY USER	BY USER												
CV or beta (Min Qty, Max Qty)	BY USER	BY USER	BY USER												
Quantity Unit:	BY USER	BY USER	BY USER												
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER	BY USER												
Best Fit Distribution:	BY USER	BY USER	BY USER												
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER	BY USER												
Average Repair Time (Min Qty, Max Qty)	BY USER	BY USER	BY USER												
CV or beta (Min Qty, Max Qty)	BY USER	BY USER	BY USER												
Quantity Unit:	BY USER	BY USER	BY USER												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	confirm damage state, repair, lead time, and casualty data. This component requires user specified cost and time consequence data. Values within PACT are defaults														
Date Created:	By User														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	By User														
Revisions:	None														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B2023.056
Storefront, Config: Symmetric insulating glass units (dual-pane, equal-thickness IGU), Lamination: Not laminated, Glass Type: Full tempered, Details: 1 in. (25 mm) FT IGL
None

Line 342

Construction Quality: Not Specified

Seismic Installation Conditions: Not Specified

Fragility Unit of Measure: SF 30

Demand Parameter (unit): Story Drift RatioUnit less

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1)

Descriptions: Damage State by User

Quantity RoundingRound Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO

No

Illustrations

none

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User
Not Specified
Not Specified
By User
NO
YES
Not Rated
Not Rated
Not Rated
Not Rated
Repair by User

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER	BY USER												
Best Fit Distribution:	BY USER	BY USER	BY USER												
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER	BY USER												
Average Repair Cost (Min Qty, Max Qty)	BY USER	BY USER	BY USER												
CV or beta (Min Qty, Max Qty)	BY USER	BY USER	BY USER												
Quantity Unit:	BY USER	BY USER	BY USER												
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER	BY USER												
Best Fit Distribution:	BY USER	BY USER	BY USER												
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER	BY USER												
Average Repair Time (Min Qty, Max Qty)	BY USER	BY USER	BY USER												
CV or beta (Min Qty, Max Qty)	BY USER	BY USER	BY USER												
Quantity Unit:	BY USER	BY USER	BY USER												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	confirm damage state, repair, lead time, and casualty data. This component requires user specified cost and time consequence data. Values within PACT are defaults														
Date Created:	By User														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	By User														
Revisions:	None														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification B3011.011
NISTIR Name Concrete tile roof, tiles secured and compliant with UBC94
Description Costing per roofing square (100 SF)

Line 345

Construction Quality:	Any				
Seismic Installation Conditions:	Compliant with UBC 1994				
Fragility Unit of Measure:	SF 100				
Demand Parameter (unit):	Peak Floor Acceleration	g			
Number of Damage States:	2				
Damage State:	DS1	DS2			
Type of Damage State:	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Minor damage; tiles dislodged.	Major portion of tile dislodged.			

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Illustrations					
	B3011.011-DS1-1.JPG	B3011.011-DS2-1.JPG			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	1.1	1.4			
Data dispersion, β_d :	0.28	0.28			
Uncertainty, β_u :	0.25	0.25			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Reinstall dislodged tiles.	Reinstall dislodged tiles.			

Long Lead Time (Yes / No)			NO			NO											
Repair Costs: Repair Cost by Damage State: Best fit mean: Best Fit Distribution: Quantity Plateau (Min Qty, Max Qty) Average Repair Cost (Min Qty, Max Qty) CV or beta (Min Qty, Max Qty) Quantity Unit:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀		
	4.00E+02	7.00E+02	1.57E+03	1.15E+03	1.48E+03	2.39E+03											
		7.43E+02			1.59E+03												
		LogNormal			LogNormal												
	13.00		130.00	13.00		130.00											
	8.40E+02		4.90E+02	2.22E+03		1.18E+03											
	0.58		0.58	0.31		0.31											
	100 ft² Units			100 ft² Units													
Repair Time: Repair Time by Damage State: Best fit mean: Best Fit Distribution: Quantity Plateau (Min Qty, Max Qty) Average Repair Time (Min Qty, Max Qty) CV or beta (Min Qty, Max Qty) Quantity Unit:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀		
	4.00E-01	8.00E-01	1.70E+00	1.30E+00	1.60E+00	2.60E+00											
		8.00E-01			1.60E+00												
		LogNormal			LogNormal												
	13.00		130.00	13.00		130.00											
	9.54E-01		5.68E-01	2.42E+00		1.27E+00											
	0.63		0.63	0.40		0.40											
	100 ft² Units			100 ft² Units													
LifeSafety Hazard: Potential non-collapse casualties? (Yes / No) Casualty-affected Planar Area (sf) per Normative Unit: Serious Injury (Median, Dispersion) Loss of Life (Median, Dispersion) Post-event Tagging Flag: Unsafe Placard Trigger (Median, Dispersion)	NO			NO													
	Not Applicable			Not Applicable													
	0%	0.00		0%	0.00												
	0%	0.00		0%	0.00												
	NO			YES													
	0%	0.00		50%	0.50												
	Comments: Date Created: Approved (YES / NO)? Official (YES / NO) ? Author: Revisions:	None															
Not Given												Root Cost Multiplier: 100					
By User																	
By User																	
Not Given																	
Revisions:	None																

Root Cost Multiplier: 100

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B3011.012

Clay tile roof, tiles secured and compliant with UBC94

Costing per roofing square (100 SF)

Line 346

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Any

Compliant with UBC 1994

SF 100

Peak Floor Acceleration

2

DS1

Sequential

Seq(DS1,DS2)

Minor damage; tiles dislodged.

DS2

Sequential

Major portion of tile dislodged.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO

No

Illustrations



B3011.011-DS1-1.JPG



B3011.011-DS2-1.JPG

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.00

1.00

1.4

0.2

0.25

0.3

NO

NO

Not Rated

Not Rated

Not Rated

Not Rated

Replace and install dislodged tiles (assume 5% of area)

1.7

0.20

0.25

0.3

Replace and install dislodged tiles.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Time:

LifeSafety Hazard:

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

6.25E+02

1.03E+03

2.00E+03

P₁₀

P₅₀

P₉₀

1.07E+03

2.07E+03

3.35E+03

5.00

50.00

5.00

50.00

1.33E+03

8.20E+02

3.00E+03

1.60E+03

0.48

0.48

0.37

0.37

100 ft^2 Units

P₁₀

P₅₀

P₉₀

1.35E+03

2.00E+03

3.35E+03

P₁₀

P₅₀

P₉₀

1.49E+00

2.21E+00

3.69E+00

5.00

50.00

5.00

50.00

3.31E+00

1.77E+00

0.45

0.45

100 ft^2 Units

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

NO

YES

0%

0.00

50%

0.50

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

100



FEMA P-58 Fragility Specification

NISTIR Classification B3011.013
NISTIR Name Concrete tile roof, unsecured tiles
Description Costing per roofing square (100 SF)

Line 347

Construction Quality:	Any				
Seismic Installation Conditions:	Compliant with UBC 1994				
Fragility Unit of Measure:	SF 100				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	2				
Damage State:	DS1	DS2			
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Minor damage; tiles dislodged.		Major portion of tile dislodged.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations	<div></div> <div></div> <div></div> <div></div> <div></div>				
	B3011.011-DS1-1.JPG	B3011.011-DS2-1.JPG			
Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.5	0.7			
Data dispersion, β_d :	0.28	0.28			
Uncertainty, β_u :	0.25	0.25			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Reinstall dislodged tiles.		Reinstall dislodged tiles.		

Long Lead Time (Yes / No)				NO			NO																	
Repair Costs:										P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀						
Repair Cost by Damage State:										3.25E+02	6.25E+02	1.49E+03	7.00E+02	1.03E+03	1.94E+03									
Best fit mean:										6.56E+02			1.10E+03											
Best Fit Distribution:										LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)										1.00		10.00		1.00		10.00								
Average Repair Cost (Min Qty, Max Qty)										8.13E+02		5.00E+02		1.55E+03		8.24E+02								
CV or beta (Min Qty, Max Qty)										0.64		0.64		0.43		0.43								
Quantity Unit:										100 ft^2 Units			100 ft^2 Units											
Repair Time:										P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀						
Repair Time by Damage State:										3.60E-01	6.90E-01	1.64E+00	7.70E-01	1.14E+00	2.14E+00									
Best fit mean:										6.90E-01			1.14E+00											
Best Fit Distribution:										LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)										1.00		10.00		1.00		10.00								
Average Repair Time (Min Qty, Max Qty)										8.97E-01		5.52E-01		1.71E+00		9.13E-01								
CV or beta (Min Qty, Max Qty)										0.68		0.68		0.50		0.50								
Quantity Unit:										100 ft^2 Units			100 ft^2 Units											
Life/Safety Hazard:																								
Potential non-collapse casualties? (Yes / No)										NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:										Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)										0%		0.00		0%		0.00								
Loss of Life (Median, Dispersion)										0%		0.00		0%		0.00								
Post-event Tagging Flag:										NO			YES											
Unsafe Placard Trigger (Median, Dispersion)										0%		0.00		50%		0.50								
Comments:										None														
Date Created:										Not Given														
Approved (YES / NO)?										By User														
Official (YES / NO) ?										By User														
Author:										Not Given														
Revisions:										None														
										Root Cost Multiplier: 100														

Root Cost Multiplier: 100



FEMA P-58 Fragility Specification

NISTIR Classification B3011.014
NISTIR Name Clay tile roof, unsecured tiles
Description Costing per roofing square (100 SF)

Line 348

Construction Quality:	Any				
Seismic Installation Conditions:	Compliant with UBC 1994				
Fragility Unit of Measure:	SF 100				
Demand Parameter (unit):	Peak Floor Acceleration	g			
Number of Damage States:	2				
Damage State:	DS1	DS2			
Type of Damage State:	Sequential	Sequential			
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Minor damage; tiles dislodged.	Major portion of tile dislodged.			

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
					
	B3011.011-DS1-1.JPG	B3011.011-DS2-1.JPG			
Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.4	0.5			
Data dispersion, β_d :	0.2	0.20			
Uncertainty, β_u :	0.25	0.25			
Total Dispersion, β :	0.3	0.3			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Replace and install dislodged tiles (assume 5% of area)	Replace and install dislodged tiles.			

Long Lead Time (Yes / No)	NO	NO			
Repair Costs:					
Repair Cost by Damage State:	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀
Best fit mean:	5.50E+02 9.50E+02 1.93E+03	9.00E+02 1.55E+03 2.90E+03			
Best Fit Distribution:	9.90E+02 LogNormal	1.58E+03 LogNormal			
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00	1.00 10.00			
Average Repair Cost (Min Qty, Max Qty)	1.24E+03 7.60E+02	2.33E+03 1.24E+03			
CV or beta (Min Qty, Max Qty)	0.51 0.51	0.47 0.47			
Quantity Unit:	100 ft^2 Units	100 ft^2 Units			
Repair Time:					
Repair Time by Damage State:	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀
Best fit mean:	6.10E-01 1.05E+00 2.12E+00	9.90E-01 1.71E+00 3.20E+00			
Best Fit Distribution:	1.05E+00 LogNormal	1.71E+00 LogNormal			
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00	1.00 10.00			
Average Repair Time (Min Qty, Max Qty)	1.36E+00 8.40E-01	2.56E+00 1.37E+00			
CV or beta (Min Qty, Max Qty)	0.57 0.57	0.53 0.53			
Quantity Unit:	100 ft^2 Units	100 ft^2 Units			
LifeSafety Hazard:					
Potential non-collapse casualties? (Yes / No)	NO	NO			
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable	Not Applicable			
Serious Injury (Median, Dispersion)	0% 0.00	0% 0.00			
Loss of Life (Median, Dispersion)	0% 0.00	0% 0.00			
Post-event Tagging Flag:	NO	YES			
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00	50% 0.50			
Comments:	None				
Date Created:	Not Given				
Approved (YES / NO)?	By User				
Official (YES / NO) ?	By User				
Author:	Not Given				
Revisions:	None				

Root Cost Multiplier: 100

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B3031.001a

Masonry Chimney - unreinforced, non industrial, above roof 5 ft, replace with masonry
Demand parameter shall be defined as the first floor peak floor acceleration. Unreinforced masonry chimney as a component of wood frame buildings. Includes firebox and chimney, excludes exterior veneer or ornamentation. May include chimneys where the quality of reinforcing is unknown. For multiple story buildings enter the chimney fragility once at the first floor, do not specify this fragility at subsequent elevated floors.

Line 349

Construction Quality:	Normal				
Seismic Installation Conditions:	All				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	2				
Damage State:	DS1	DS2			
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Cracking with offset > 1/16"		Toppling of all or a portion of the chimney.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		NO

Illustrations

				
B3031.001a-DS1-1.jpg	B3031.001a-DS2-1.jpg			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.35	0.5			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.6	0.6			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Rebuild above break or replace entire chimney. Add comments (edit or delete as necessary): Rebuilding with masonry will restore the chimney to its pre-earthquake condition. Some jurisdictions prohibit unreinforced reconstruction and require either replacement of the damaged portion of the chimney with a metal flue within wood frame chase or a complete removal of the existing fireplace and chimney with replacement with a code compliant reinforced masonry design. Toppled chimney may cause damage to adjacent structure.				

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	6.37E+03	7.23E+03	9.09E+03	6.37E+03	7.23E+03	9.09E+03									
Best fit mean:	7.47E+03			7.47E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Cost (Min Qty, Max Qty)	9.39E+03 5.78E+03			1.08E+04 5.78E+03											
CV or beta (Min Qty, Max Qty)	0.14 0.14			0.14 0.14											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	7.03E+00	7.97E+00	1.00E+01	7.03E+00	7.97E+00	1.00E+01									
Best fit mean:	7.97E+00			7.97E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Time (Min Qty, Max Qty)	1.04E+01 6.38E+00			1.20E+01 6.38E+00											
CV or beta (Min Qty, Max Qty)	0.29 0.29			0.29 0.29											
Quantity Unit:	Each			Each											
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	25% 0.50			50% 0.50											

Comments: of the damaged portion of the chimney with a metal flue within wood frame chase or a complete removal of the existing fireplace and chimney with replacement with a
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: None
Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B3031.001b

Masonry Chimney - unreinforced, non industrial, above roof 10 ft, replace with masonry
Demand parameter shall be defined as the first floor peak floor acceleration. Unreinforced masonry chimney as a component of wood frame buildings. Includes firebox and chimney, excludes exterior veneer or ornamentation. May include chimneys where the quality of reinforcing is unknown. For multiple story buildings enter the chimney fragility once at the first floor, do not specify this fragility at subsequent elevated floors.

Line 350

Construction Quality:	Normal				
Seismic Installation Conditions:	All				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	2				
Damage State:	DS1	DS2			
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Cracking with offset > 1/16"		Toppling of all or a portion of the chimney.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	NO	

Illustrations

				
B3031.001a-DS1-1.jpg	B3031.001a-DS2-1.jpg			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.35	0.5			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.6	0.6			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Rebuild above break or replace entire chimney. Add comments (edit or delete as necessary): Rebuilding with masonry will restore the chimney to its pre-earthquake condition. Some jurisdictions prohibit unreinforced reconstruction and require either replacement of the damaged portion of the chimney with a metal flue within wood frame chase or a complete removal of the existing fireplace and chimney with replacement with a code compliant reinforced masonry design. Toppled chimney may cause damage to adjacent structure.				

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	9.52E+03	1.12E+04	1.46E+04	9.52E+03	1.12E+04	1.46E+04									
Best fit mean:	1.16E+04			1.16E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Cost (Min Qty, Max Qty)	1.46E+04 8.96E+03			1.68E+04 8.96E+03											
CV or beta (Min Qty, Max Qty)	0.17 0.17			0.17 0.17											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.05E+01	1.24E+01	1.61E+01	1.05E+01	1.24E+01	1.61E+01									
Best fit mean:	1.24E+01			1.24E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Time (Min Qty, Max Qty)	1.61E+01 9.88E+00			1.85E+01 9.88E+00											
CV or beta (Min Qty, Max Qty)	0.30 0.30			0.30 0.30											
Quantity Unit:	Each			Each											
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	25% 0.50			50% 0.50											

Comments: of the damaged portion of the chimney with a metal flue within wood frame chase or a complete removal of the existing fireplace and chimney with replacement with a
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: None
Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

B3031.001c

Masonry Chimney - unreinforced, non industrial, above roof 15 ft, replace with masonry

Demand parameter shall be defined as the first floor peak floor acceleration. Unreinforced masonry chimney as a component of wood frame buildings. Includes firebox and chimney, excludes exterior veneer or ornamentation. May include chimneys where the quality of reinforcing is unknown. For multiple story buildings enter the chimney fragility once at the first floor, do not specify this fragility at subsequent elevated floors.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

All

EA 1

Peak Floor Acceleration

g

2

DS1

DS2

Sequential

Seq(DS1,DS2)

Cracking with offset > 1/16"

Toppling of all or a portion of the chimney.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)


No


No

No

No

Illustrations





B3031.001a-DS1-1.jpg

B3031.001a-DS2-1.jpg

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.00

1.00

0.35

Not Specified

Not Specified

0.6

NO

NO

Not Rated

Not Rated

Not Rated

Not Rated

Not Rated

Rebuild above break or replace entire chimney.

Rebuild above break or replace entire chimney.

Add comments (edit or delete as necessary):

Rebuilding with masonry will restore the chimney to its pre-earthquake condition. Some jurisdictions prohibit unreinforced reconstruction and require either replacement of the damaged portion of the chimney with a metal flue within wood frame chase or a complete removal of the existing fireplace and chimney with replacement with a code compliant reinforced masonry design. Toppled chimney may cause damage to adjacent structure.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.27E+04

1.52E+04

2.01E+04

1.27E+04

1.52E+04

2.01E+04

1.57E+04

LogNormal

1.00

5.00

1.00

5.00

1.97E+04

1.21E+04

0.19

0.19

Each

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.40E+01

1.67E+01

2.21E+01

1.40E+01

1.67E+01

2.21E+01

1.67E+01

LogNormal

1.00

5.00

1.00

5.00

2.18E+01

1.34E+01

0.31

0.31

Each

Each

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

YES

YES

25%

0.50

50%

0.50

of the damaged portion of the chimney with a metal flue within wood frame chase or a complete removal of the existing fireplace and chimney with replacement with a

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B3031.002a

Masonry Chimney - unreinforced, non industrial, above roof 5 ft, replace with framing
Demand parameter shall be defined as the first floor peak floor acceleration. Unreinforced masonry chimney as a component of wood frame buildings. Includes firebox and chimney, excludes exterior veneer or ornamentation. May include chimneys where the quality of reinforcing is unknown. For multiple story buildings enter the chimney fragility once at the first floor, do not specify this fragility at subsequent elevated floors.

Line 352

Construction Quality:	Normal				
Seismic Installation Conditions:	All				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	2				
Damage State:	DS1		DS2		
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Cracking with offset > 1/16"		Toppling of all or a portion of the chimney.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	NO	

Illustrations

				
B3031.001a-DS1-1.jpg	B3031.001a-DS2-1.jpg			

Damage State Probability:		1.00	1.00		
Fragility Parameters					
Median Demand, θ :		0.35	0.5		
Data dispersion, β_d :		Not Specified	Not Specified		
Uncertainty, β_u :		Not Specified	Not Specified		
Total Dispersion, β :		0.6	0.6		
Correlation (Yes / No)		NO			
Directionality (Yes / No)		NO			
Quality Ratings					
Data Quality		Not Rated			
Data Relevance		Not Rated			
Documentation Quality		Not Rated			
Rationality		Not Rated			
Consequence Functions					
Repair Description		Rebuild above break or replace entire	Rebuild above break or replace entire		

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	4.50E+03	6.53E+03	8.11E+03	4.50E+03	6.53E+03	8.11E+03									
Best fit mean:	6.37E+03			6.37E+03											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Cost (Min Qty, Max Qty)	9.79E+03		5.22E+03	9.79E+03		5.22E+03									
CV or beta (Min Qty, Max Qty)	0.22		0.22	0.22		0.22									
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	4.96E+00	7.20E+00	8.94E+00	4.96E+00	7.20E+00	8.94E+00									
Best fit mean:	7.20E+00			7.20E+00											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Time (Min Qty, Max Qty)	1.08E+01		5.76E+00	1.08E+01		5.76E+00									
CV or beta (Min Qty, Max Qty)	0.33		0.33	0.33		0.33									
Quantity Unit:	Each			Each											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	25%	0.50		50%	0.50										

Comments: of the damaged portion of the chimney with a metal flue within wood frame chase or a complete removal of the existing fireplace and chimney with replacement with a
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: None
Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

B3031.002b

Masonry Chimney - unreinforced, non industrial, above roof 10 ft, replace with framing
Demand parameter shall be defined as the first floor peak floor acceleration. Unreinforced masonry chimney as a component of wood frame buildings. Includes firebox and chimney, excludes exterior veneer or ornamentation. May include chimneys where the quality of reinforcing is unknown. For multiple story buildings enter the chimney fragility once at the first floor, do not specify this fragility at subsequent elevated floors.

Line 353

Construction Quality:	Normal			
Seismic Installation Conditions:	All			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	2			
Damage State:	DS1	DS2		
Type of Damage State:	Sequential		Sequential	
DS Hierarchy	Seq(DS1,DS2)			
Descriptions	Cracking with offset > 1/16"		Toppling of all or a portion of the chimney.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	NO	

Illustrations

				
B3031.001a-DS1-1.jpg	B3031.001a-DS2-1.jpg			

Damage State Probability:	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	0.35	0.5			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.6	0.6			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Rebuild above break or replace entire chimney. Add comments (edit or delete as necessary): Rebuilding with masonry will restore the chimney to its pre-earthquake condition. Some jurisdictions prohibit unreinforced reconstruction and require either replacement of the damaged portion of the chimney with a metal flue within wood frame chase or a complete removal of the existing fireplace and chimney with replacement with a code compliant reinforced masonry design. Toppled chimney may cause damage to adjacent structure.				

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	8.27E+03	9.80E+03	1.27E+04	8.27E+03	9.80E+03	1.27E+04									
Best fit mean:	1.01E+04			1.01E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			1.00											
Average Repair Cost (Min Qty, Max Qty)	1.47E+04			1.47E+04											
CV or beta (Min Qty, Max Qty)	0.17			0.17											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.12E+00	1.08E+01	1.40E+01	9.12E+00	1.08E+01	1.40E+01									
Best fit mean:	1.08E+01			1.08E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00			1.00											
Average Repair Time (Min Qty, Max Qty)	1.62E+01			1.62E+01											
CV or beta (Min Qty, Max Qty)	0.30			0.30											
Quantity Unit:	Each			Each											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	YES			YES											
Unsafe Placard Trigger (Median, Dispersion)	25% 0.50			50% 0.50											

Comments: of the damaged portion of the chimney with a metal flue within wood frame chase or a complete removal of the existing fireplace and chimney with replacement with a
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: None

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

B3031.002c

Masonry Chimney - unreinforced, non industrial, above roof 15 ft, replace with framing

Demand parameter shall be defined as the first floor peak floor acceleration. Unreinforced masonry chimney as a component of wood frame buildings. Includes firebox and chimney, excludes exterior veneer or ornamentation. May include chimneys where the quality of reinforcing is unknown. For multiple story buildings enter the chimney fragility once at the first floor, do not specify this fragility at subsequent elevated floors.

Normal

All

EA 1

Peak Floor Acceleration

g

2

DS1

DS2

Sequential

Seq(DS1,DS2)

Cracking with offset > 1/16"

Toppling of all or a portion of the chimney.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)


NO


NO

NO

No

Illustrations





B3031.001a-DS1-1.jpg

B3031.001a-DS2-1.jpg

Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

0.35

Not Specified

Not Specified

0.6

NO

NO

Not Rated

Not Rated

Not Rated

Not Rated

Rebuild above break or replace entire chimney.

Rebuild above break or replace entire chimney.

Add comments (edit or delete as necessary):

Rebuilding with masonry will restore the chimney to its pre-earthquake condition. Some jurisdictions prohibit unreinforced reconstruction and require either replacement of the damaged portion of the chimney with a metal flue within wood frame chase or a complete removal of the existing fireplace and chimney with replacement with a code compliant reinforced masonry design. Toppled chimney may cause damage to adjacent structure.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Each

Each

P₁₀

P₅₀

P₉₀

9.54E+03

1.31E+04

1.48E+04

P₁₀

P₅₀

P₉₀

9.54E+03

1.31E+04

1.48E+04

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.25E+04

Normal

1.00

5.00

1.00

5.00

1.96E+04

1.05E+04

1.96E+04

1.05E+04

0.16

0.16

0.16

0.16

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Each

Each

P₁₀

P₅₀

P₉₀

1.05E+01

1.44E+01

1.63E+01

P₁₀

P₅₀

P₉₀

1.05E+01

1.44E+01

1.63E+01

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.44E+01

Normal

1.00

5.00

1.00

5.00

2.16E+01

1.15E+01

2.16E+01

1.15E+01

0.30

0.30

0.30

0.30

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

YES

25%

0.50

NO

Not Applicable

0%

0.00

0%

0.00

YES

50%

0.50

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO)?

Author:

Revisions:

of the damaged portion of the chimney with a metal flue within wood frame chase or a complete removal of the existing fireplace and chimney with replacement with a

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification


NISTIR Name

Description

B3041.001
Masonry Parapet - unreinforced, unbraced
Unreinforced and unbraced masonry parapet as a component of a masonry building. Parapet height / width of approximately 3. Costing based upon repair of 3ft tall x 10ft segment.

Line 355

Construction Quality:	Normal				<div>Quantity Rounding</div> <div>Round Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	All				
Fragility Unit of Measure:	LF 10				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	2				
Damage State:	DS1		DS2		
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Cracking with offset > 1/16"		Toppling of all or portion of parapet.		

Illustrations				
				
	B2012.001a-DS1-1.jpg	B2012.001a-DS2-1.jpg		
Damage State Probability:	1.00	1.00		
Fragility Parameters				
Median Demand, θ :	0.2	0.4		
Data dispersion, β_d :	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified		
Total Dispersion, β :	0.6	0.6		
Correlation (Yes / No)	NO			
Directionality (Yes / No)	NO			
Quality Ratings				
Data Quality	Not Rated			
Data Relevance	Not Rated			
Documentation Quality	Not Rated			
Rationality	Not Rated			
Consequence Functions				
Repair Description	Replace and reinforce		Replace and reinforce	

Long Lead Time (Yes / No)				NO			NO																	
Repair Costs:										P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀						
Repair Cost by Damage State:										3.40E+02	5.40E+02	6.70E+02	3.40E+02	5.40E+02	6.70E+02									
Best fit mean:										5.17E+02			5.17E+02											
Best Fit Distribution:										Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)										10.00		50.00		10.00		50.00								
Average Repair Cost (Min Qty, Max Qty)										8.10E+02		4.32E+02		8.10E+02		4.32E+02								
CV or beta (Min Qty, Max Qty)										0.25		0.25		0.25		0.25								
Quantity Unit:										LF 10			LF 10											
Repair Time:										P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀						
Repair Time by Damage State:										3.30E-01	5.24E-01	6.50E-01	3.30E-01	5.24E-01	6.50E-01									
Best fit mean:										5.01E-01			5.01E-01											
Best Fit Distribution:										Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)										10.00		50.00		10.00		50.00								
Average Repair Time (Min Qty, Max Qty)										7.86E-01		4.19E-01		7.86E-01		4.19E-01								
CV or beta (Min Qty, Max Qty)										0.35		0.35		0.35		0.35								
Quantity Unit:										LF 10			LF 10											
LifeSafety Hazard:																								
Potential non-collapse casualties? (Yes / No)										NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:										Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)										0%		0.00		0%		0.00								
Loss of Life (Median, Dispersion)										0%		0.00		0%		0.00								
Post-event Tagging Flag:										YES			YES											
Unsafe Placard Trigger (Median, Dispersion)										25%		0.50		50%		0.50								
Comments:										None														
Date Created:										Not Given														
Approved (YES / NO)?										By User														
Official (YES / NO) ?										By User														
Author:										Not Given														
Revisions:										2016-09-14 Costing revised to represent a 3ft tall x 10ft segment.														
										Root Cost Multiplier: 1														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

C1011.001a

Wall Partition, Type: Gypsum with metal studs, Full Height, Fixed Below, Fixed Above
Quantity is based upon 13'x100' Panels. Quantity of wall damaged varies by damage state.

Line 356

Construction Quality:	Normal			<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Unknown			
Fragility Unit of Measure:	LF 100			
Demand Parameter (unit):	Story Drift Ratio	Unit less		
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Screw pop-out, cracking of wall board, warping or cracking of tape, slight crushing of wall panel at corners.	Moderate cracking or crushing of gypsum wall boards (typically in corners). Moderate corner gap openings, bending of boundary studs.	Buckling of studs and tearing of tracks. Tearing or bending of top track, tearing at corners with transverse walls, large gap openings, walls displaced.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	0.005	0.01	0.021	
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified	
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified	
Total Dispersion, β :	0.4	0.3	0.2	
Correlation (Yes / No)	NO			
Directionality (Yes / No)	YES			
Quality Ratings				
Data Quality	Superior			
Data Relevance	Superior			
Documentation Quality	Superior			
Rationality	Not Rated			
Consequence Functions				
Repair Description				

Retape joints, paste and repaint. May require cutting and replacing corner sections of board. Repair 5% wallboard, 10% retape, 25% repaint.

Remove and replace 10% of wall board (both sides), retape and paste 25% of wall, paint 50% of wall. Replace boundary studs of approximately 5 intersections per 100 ft of wall length.

Remove and replace 50% of length of metal stud wall, 50% of both sides of the gypsum, and any embedded utilities. Retape and paste as required. Repaint 100%.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	7.00E+02	2.28E+03	2.93E+03	1.85E+03	4.55E+03	8.70E+03	7.15E+03	8.75E+03	1.17E+04						
Best fit mean:	1.97E+03			4.30E+03			8.99E+03								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00		10.00	1.00		10.00	1.00		10.00						
Average Repair Cost (Min Qty, Max Qty)	3.41E+03		1.82E+03	6.83E+03		3.64E+03	1.05E+04		7.44E+03						
CV or beta (Min Qty, Max Qty)	0.44		0.44	0.56		0.56	0.20		0.20						
Quantity Unit:	1300 ft^2			1300 ft^2			1300 ft^2								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.20E-01	1.82E+00	2.34E+00	1.43E+00	3.51E+00	6.76E+00	5.59E+00	6.76E+00	9.10E+00						
Best fit mean:	1.82E+00			3.51E+00			6.76E+00								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00		10.00	1.00		10.00	1.00		10.00						
Average Repair Time (Min Qty, Max Qty)	2.71E+00		1.47E+00	5.28E+00		2.80E+00	8.12E+00		5.74E+00						
CV or beta (Min Qty, Max Qty)	0.51		0.51	0.61		0.61	0.32		0.32						
Quantity Unit:	1300 ft^2			1300 ft^2			1300 ft^2								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00						
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00						
Post-event Tagging Flag:	NO			NO			NO								
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00						

Root Cost Multiplier: 1300

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

C1011.001b

Wall Partition, Type: Gypsum with metal studs, Partial Height, Fixed Below, Lateral Braced Above
Quantity is based upon 13'x100' Panels. Quantity of wall damaged varies by damage state.

Line 357

Construction Quality:	Normal			<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Unknown			
Fragility Unit of Measure:	LF 100			
Demand Parameter (unit):	Story Drift Ratio	Unit less		
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Screw pop-out, cracking of wall board, warping or cracking of tape, slight crushing of wall panel at corners.	Moderate cracking or crushing of gypsum wall boards (typically in corners). Moderate corner gap openings, bending of boundary studs.	Buckling of studs and tearing of tracks. Tearing or bending of top track, tearing at corners with transverse walls, large gap openings, walls displaced.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	0.01	0.013	0.018	
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified	
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified	
Total Dispersion, β :	0.3	0.3	0.3	
Correlation (Yes / No)	NO			
Directionality (Yes / No)	YES			
Quality Ratings				
Data Quality	Superior			
Data Relevance	Superior			
Documentation Quality	Superior			
Rationality	Not Rated			
Consequence Functions				
Repair Description				

Retape joints, paste and repaint. May require cutting and replacing corner sections of board. Repair 5% wallboard, 10% retape, 25% repaint.

Remove and replace 10% of wall board (both sides), retape and paste 25% of wall, paint 50% of wall. Replace boundary studs of approximately 5 intersections per 100 ft of wall length.

Remove and replace 50% of length of metal stud wall, 50% of both sides of the gypsum, and any embedded utilities. Retape and paste as required. Repaint 100%.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	7.00E+02	2.28E+03	2.93E+03	1.85E+03	4.55E+03	8.70E+03	7.15E+03	8.75E+03	1.17E+04						
Best fit mean:	1.97E+03			4.30E+03			8.99E+03								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00		10.00	1.00		10.00	1.00		10.00						
Average Repair Cost (Min Qty, Max Qty)	4.55E+03		1.37E+03	9.10E+03		2.73E+03	1.75E+04		5.25E+03						
CV or beta (Min Qty, Max Qty)	0.44		0.44	0.56		0.56	0.20		0.20						
Quantity Unit:	1300 ft^2			1300 ft^2			1300 ft^2								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.20E-01	1.82E+00	2.34E+00	1.43E+00	3.51E+00	6.76E+00	5.59E+00	6.76E+00	9.10E+00						
Best fit mean:	1.82E+00			3.51E+00			6.76E+00								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00		10.00	1.00		10.00	1.00		10.00						
Average Repair Time (Min Qty, Max Qty)	3.59E+00		1.11E+00	7.06E+00		2.09E+00	1.36E+01		4.03E+00						
CV or beta (Min Qty, Max Qty)	0.51		0.51	0.61		0.61	0.32		0.32						
Quantity Unit:	1300 ft^2			1300 ft^2			1300 ft^2								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00						
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00						
Post-event Tagging Flag:	NO			NO			NO								
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00						

Root Cost Multiplier: 1300

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

C1011.001c

Wall Partition, Type: Gypsum with metal studs, Full Height, Fixed Below, Slip Track Above with returns
Quantity is based upon 13'x100' Panels. Quantity of wall damaged varies by damage state.

Line 358

Construction Quality:	Normal			<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Unknown			
Fragility Unit of Measure:	LF 100			
Demand Parameter (unit):	Story Drift Ratio	Unit less		
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Screw pop-out, cracking of wall board, warping or cracking of tape, slight crushing of wall panel at corners.	Moderate cracking or crushing of gypsum wall boards (typically in corners). Moderate corner gap openings, bending of boundary studs.	Buckling of studs and tearing of tracks. Tearing or bending of top track, tearing at corners with transverse walls, large gap openings, walls displaced.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	0.004	0.011	0.019	
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified	
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified	
Total Dispersion, β :	0.45	0.35	0.25	
Correlation (Yes / No)	NO			
Directionality (Yes / No)	YES			
Quality Ratings				
Data Quality	Superior			
Data Relevance	Superior			
Documentation Quality	Superior			
Rationality	Not Rated			
Consequence Functions				
Repair Description				

Retape joints, paste and repaint. May require cutting and replacing corner sections of board. Repair 5% wallboard, 10% retape, 25% repaint.

Remove and replace 10% of wall board (both sides), retape and paste 25% of wall, paint 50% of wall. Replace boundary studs of approximately 5 intersections per 100 ft of wall length.

Remove and replace 50% of length of metal stud wall, 50% of both sides of the gypsum, and any embedded utilities. Retape and paste as required. Repaint 100%.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.80E+02	9.10E+02	1.17E+03	7.40E+02	1.82E+03	3.48E+03	2.86E+03	3.50E+03	4.66E+03						
Best fit mean:	7.87E+02			1.72E+03			3.60E+03								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00	10.00		1.00	10.00		1.00	10.00							
Average Repair Cost (Min Qty, Max Qty)	1.82E+03	5.46E+02		3.64E+03	1.09E+03		7.00E+03	2.10E+03							
CV or beta (Min Qty, Max Qty)	0.44	0.44		0.56	0.56		0.20	0.20							
Quantity Unit:	1300 ft^2			1300 ft^2			1300 ft^2								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.60E-01	6.50E-01	9.10E-01	5.20E-01	1.43E+00	2.73E+00	2.21E+00	2.73E+00	3.64E+00						
Best fit mean:	6.50E-01			1.43E+00			2.73E+00								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00	10.00		1.00	10.00		1.00	10.00							
Average Repair Time (Min Qty, Max Qty)	1.36E+00	3.66E-01		2.85E+00	8.63E-01		5.46E+00	1.64E+00							
CV or beta (Min Qty, Max Qty)	0.51	0.51		0.61	0.61		0.32	0.32							
Quantity Unit:	1300 ft^2			1300 ft^2			1300 ft^2								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			NO								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							

Root Cost Multiplier: 1300

Line 359

Wall Partition, Type: Gypsum with metal studs, Full Height, Fixed Below, Slip Track Above w/o returns (friction connections)
Quantity is based upon 13'x100' Panels. Quantity of wall damaged varies by damage state.

Illustrations

Long Lead Time (Yes / No)

Dispersion:	0%	0.00	0%	0.00		
Comments:	None					
Date Created:	Not Given				Root Cost Multiplier:	1300
Approved (YES / NO)?	By User					
Official (YES / NO) ?	By User					
Author:	Not Given					
Revisions:	2015-07-26 Revised DS1,2,3 description, consequence text; 2015-08-13 Removed DS3 data - no such damage state or consequence; 2016-03-08 Revised for new cost and time consequence data					

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

C1011.011a

Wall Partition, Type: Gypsum with wood studs, Full Height, Fixed Below, Fixed Above
Quantity is based upon 13'x100' Panels. Quantity of wall damaged varies by damage state.

Line 360

Construction Quality:	Normal				<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Unknown				
Fragility Unit of Measure:	LF 100				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,MutEx(DS2,DS3))				
Descriptions	Cracking of paint over fasteners or joints.	Local and global buckling out-of-plane and crushing of gypsum wallboards. Studs are typically not damaged by failure of the gypsum wallboard.	Local and global buckling out-of-plane and crushing of gypsum wallboards. Studs are typically not damaged by failure of the gypsum wallboard.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Illustrations

Damage State Probability:	none	none	none		
	1.00	0.80	0.20		
Fragility Parameters					
Median Demand, θ :	0.0021	0.0071	0.0071		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	0.6	0.45	0.45		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Superior				
Data Relevance	Superior				
Documentation Quality	Superior				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Gypsum wallboard repaired by replacing the tape along the seam of two adjacent panels, applying new joint compound, sanding, and repainting.	Replace 25 feet of the affected panel along with the application of new tape, joint compound, followed by sanding and repainting. Studs are not damaged.	Replace 100 feet of the affected panel along with the application of new tape, joint compound, followed by sanding and repainting. Studs are not damaged.		

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	7.00E+02	2.66E+03	3.00E+03	2.05E+03	5.55E+03	8.90E+03	1.80E+04	1.88E+04	2.28E+04						
Best fit mean:	2.12E+03			5.50E+03			1.98E+04								
Best Fit Distribution:	Normal			Normal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00		10.00	1.00		10.00	1.00		10.00						
Average Repair Cost (Min Qty, Max Qty)	5.32E+03		1.60E+03	1.11E+04		3.33E+03	3.76E+04		1.13E+04						
CV or beta (Min Qty, Max Qty)	0.42		0.42	0.49		0.49	0.10		0.10						
Quantity Unit:	1300 ft^2			1300 ft^2			1300 ft^2								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.20E-01	2.08E+00	2.34E+00	1.56E+00	4.29E+00	6.89E+00	1.40E+01	1.47E+01	1.78E+01						
Best fit mean:	2.08E+00			4.29E+00			1.47E+01								
Best Fit Distribution:	Normal			Normal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00		10.00	1.00		10.00	1.00		10.00						
Average Repair Time (Min Qty, Max Qty)	4.15E+00		1.25E+00	8.62E+00		2.56E+00	2.93E+01		8.83E+00						
CV or beta (Min Qty, Max Qty)	0.49		0.49	0.55		0.55	0.27		0.27						
Quantity Unit:	1300 ft^2			1300 ft^2			1300 ft^2								
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			NO								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	2016-03-08 Revised for new cost and time consequence data														

Root Cost Multiplier: 1300

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

C2011.001b

Prefabricated steel stair with steel treads and landings with no seismic joint.
Flexible stair without seismic interstory slip joint. Steel prefab stringers, steel or concrete filled pan treads.

Line 362

Construction Quality: Normal

Seismic Installation Conditions: All

Fragility Unit of Measure: EA 1

Demand Parameter (unit): Story Drift Ratio Unit less

Number of Damage States: 3

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1,DS2,DS3)

Descriptions: Non structural damage, local steel yielding.

DS2

Sequential

Seq(DS1,DS2,DS3)

Buckling of steel, weld cracking.

DS3

Sequential

Seq(DS1,DS2,DS3)

Loss of live load capacity. Connection and or weld fracture.

Quantity Rounding Round Qty? YES
Allow sum by floor or building? FLR
Demand Location (floor above?) No

Illustrations



Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.00

0.005

Not Specified

Not Specified

0.6

NO

YES

Marginal

Marginal

Average

Not Rated

Patch, paint.

1.00

0.017

Not Specified

Not Specified

0.6

NO

YES

Marginal

Marginal

Average

Not Rated

Removal and replacement of damaged components. Field repair of damage (such as welding). Repair finishes.

1.00

0.028

Not Specified

Not Specified

0.45

NO

YES

Marginal

Marginal

Average

Not Rated

Replace stair and handrail. Repair and replace affected soffits and floor finishes.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.00E+02	4.00E+02	1.40E+03	1.30E+03	2.70E+03	5.70E+03	9.90E+03	2.00E+04	3.02E+04						
Best fit mean:	3.94E+02			2.71E+03			2.00E+04								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00	10.00		5.00	10.00		5.00	10.00							
Average Repair Cost (Min Qty, Max Qty)	8.00E+02	2.40E+02		5.40E+03	1.62E+03		3.99E+04	1.20E+04							
CV or beta (Min Qty, Max Qty)	0.99	0.99		0.58	0.58		0.40	0.40							
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.10E-01	4.41E-01	1.54E+00	1.43E+00	2.98E+00	6.29E+00	1.09E+01	2.20E+01	3.33E+01						
Best fit mean:	4.41E-01			2.98E+00			2.20E+01								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00	10.00		5.00	10.00		5.00	10.00							
Average Repair Time (Min Qty, Max Qty)	8.82E-01	2.65E-01		5.96E+00	1.79E+00		4.40E+01	1.32E+01							
CV or beta (Min Qty, Max Qty)	1.02	1.02		0.63	0.63		0.47	0.47							
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		25%	0.50		10%	0.50							

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO)?

Author:

Revisions:

Confirm median demand and dispersion values

Not Given

By User

By User

Not Given

2011-08-24 DS2 beta changed from 0.08 to 0.15 to avoid negative probability above 0.5% drift.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

C2011.011a

Non-monolithic precast concrete stair assembly with concrete stringers and treads with seismic joints that accommodate drift.
Rigid stair with seismic interstory drift joint. Precast concrete stair.

Line 363

Construction Quality:	Normal			<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? FLR</div> <div>Demand Location (floor above)? No</div>	
Seismic Installation Conditions:	All				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift RatioUnit less				
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Non structural damage, local concrete cracking, localized concrete spalling, localized rebar yielding.	Structural damage but live load capacity remains intact. Extensive concrete cracking, concrete crushing, buckling of	Loss of live load capacity. Extensive concrete crushing, connection failure.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?	FLR	
Demand Location (floor above?)	No	

Illustrations

				
C2011.011a-DS1-1.jpg	C2011.011a-DS2-1.jpg	C2011.011a-DS2-1.jpg		
1.00	1.00	1.00		

Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	By User	By User	By User		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	By User	By User	By User		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Marginal				
Documentation Quality	Average				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Patch, paint, epoxy injection. Repair finishes.	Remove damaged components, install replacement components.	Replace stair and handrail. Repair and replace affected soffits and floor finishes.		

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Cost by Damage State:	1.00E+02	7.00E+02	1.70E+03	1.80E+03	3.70E+03	7.70E+03	1.26E+04	2.30E+04	3.41E+04						
Best fit mean:	6.14E+02			3.71E+03			2.32E+04								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00			5.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	1.40E+03 0.80			7.40E+03 0.57			4.59E+04 0.36			1.38E+04 0.36					
CV or beta (Min Qty, Max Qty)	0.80			0.57			0.36			0.36					
Quantity Unit:	Each			Each			Each								
Repair Time:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Time by Damage State:	1.10E+01	7.72E+01	1.88E+00	1.99E+00	4.08E+00	8.49E+00	1.39E+01	2.53E+01	3.76E+01						
Best fit mean:	7.72E+01			4.08E+00			2.53E+01								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00			5.00 10.00								
Average Repair Time (Min Qty, Max Qty)	1.54E+00 0.84			8.16E+00 0.62			5.06E+01 0.44			1.52E+01 0.44					
CV or beta (Min Qty, Max Qty)	0.84			0.62			0.44			0.44					
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			25% 0.50			10% 0.50								

Comments: User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: None

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

C2011.011b

NISTIR Name

Non-monolithic precast concrete stair assembly with concrete stringers and treads with no seismic joint.

Description

Rigid stair without seismic interstory drift joint. Precast concrete stair.

Line 364

Construction Quality:

Normal

Seismic Installation Conditions:

All

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Story Drift Ratio

Unit less

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

Non structural damage, local concrete cracking, localized concrete spalling, localized rebar yielding.

Structural damage but live load capacity remains intact. Extensive concrete cracking, concrete crushing, buckling of rebar.

Loss of live load capacity. Extensive concrete crushing, connection failure.

Quantity Rounding

Round Qty? YES

Allow sum by floor or building? FLR

Demand Location (floor above?) No

Illustrations



Damage State Probability:

1.00

1.00

1.00

Fragility Parameters

Median Demand, θ :

0.005

0.017

0.028

Data dispersion, β_d :

Not Specified

Not Specified

Not Specified

Uncertainty, β_u :

Not Specified

Not Specified

Not Specified

Total Dispersion, β_t :

0.6

0.6

0.45

Correlation (Yes / No)

NO

Directionality (Yes / No)

YES

Quality Ratings

Data Quality

Marginal

Data Relevance

Marginal

Documentation Quality

Average

Rationality

Not Rated

Consequence Functions

Repair Description

Patch, paint, epoxy injection. Repair finishes.

Remove damaged components, install replacement components.

Replace stair and handrail. Repair and replace affected soffits and floor finishes.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.00E+02	7.00E+02	1.70E+03	1.80E+03	3.70E+03	7.70E+03	1.26E+04	2.30E+04	3.41E+04						
Best fit mean:	6.14E+02			3.71E+03			2.32E+04								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00			5.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	1.40E+03 0.80			7.40E+03 0.57			4.59E+04 0.36			1.38E+04 0.36					
CV or beta (Min Qty, Max Qty)	0.80			0.57			0.36			0.36					
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.10E-01	7.72E-01	1.88E+00	1.99E+00	4.08E+00	8.49E+00	1.39E+01	2.53E+01	3.76E+01						
Best fit mean:	7.72E-01			4.08E+00			2.53E+01								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00			5.00 10.00								
Average Repair Time (Min Qty, Max Qty)	1.54E+00 0.84			8.16E+00 0.62			5.06E+01 0.44			1.52E+01 0.44					
CV or beta (Min Qty, Max Qty)	0.84			0.62			0.44			0.44					
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			25% 0.50			10% 0.50								

Comments:

demand and dispersion values listed are from a best fit approximation of the data performed by MKA.

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

None

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

C2011.021a

Monolithic cast-in-place and precast concrete stairs with seismic joints that accommodate drift - replace in kind if replacement is required.
Cast in place concrete stair, with seismic interstory drift joint

Line 365

Construction Quality:	Normal			
Seismic Installation Conditions:	All			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Story Drift Ratio Unit less			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Local concrete cracking, localized concrete spalling	Extensive concrete cracking, concrete crushing	Loss of live load capacity.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?	FLR	
Demand Location (floor above?)	No	

Illustrations

C2011.011a-DS1-1.jpg	C2011.011a-DS2-1.jpg	C2011.011a-DS2-1.jpg		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	By User	By User	By User		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	By User	By User	By User		

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Marginal
Data Relevance Marginal
Documentation Quality Average
Rationality Not Rated
Consequence Functions

Repair Description
Protect surrounding space, epoxy inject cracks, repair finishes. Modify or relocate mechanical and electrical as required for repair work. Repair finishes.
Protect floor, cut out damaged areas, repair buckled rebar, patch / cast concrete, repair finishes. Modify or relocate mechanical and electrical as required for repair work. Repair finishes.
Protect area, remove damaged stair including landings and handrails. Remove and reinstall damaged soffit and mechanical systems. Replace stair, landings, and handrail. Modify or relocate mechanical and electrical as required for repair work. Repair finishes.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Cost by Damage State:	1.00E+02	7.00E+02	1.70E+03	1.80E+03	3.70E+03	7.70E+03	1.44E+04	2.50E+04	3.67E+04						
Best fit mean:	6.14E+02			3.71E+03			2.63E+04								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	9.10E+02 0.80			4.44E+03 0.57			2.99E+04 0.34								
CV or beta (Min Qty, Max Qty)	0.80			0.57			0.34								
Quantity Unit:	Each			Each			Each								
Repair Time:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Time by Damage State:	1.10E-01	7.72E-01	1.88E+00	1.99E+00	4.08E+00	8.49E+00	1.59E+01	2.75E+01	4.05E+01						
Best fit mean:	7.72E-01			4.08E+00			2.75E+01								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Time (Min Qty, Max Qty)	1.00E+00 0.84			4.90E+00 0.62			3.30E+01 0.42								
CV or beta (Min Qty, Max Qty)	0.84			0.62			0.42								
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable								
Casualty-affected Planar Area (sf) per Normative Unit:	0%			0%			0%								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			25% 0.50			10% 0.50								

Comments: User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: None
Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

C2011.021b

NISTIR Name

Monolithic cast-in-place and precast concrete stairs with no seismic joints - replace in kind if replacement is required.

Description

Cast in place concrete stair, no seismic interstory drift joint

Line 366

Construction Quality: Normal

Seismic Installation Conditions: All

Fragility Unit of Measure: EA 1

Demand Parameter (unit): Story Drift Ratio Unit less

Number of Damage States: 3

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1,DS2,DS3)

Descriptions: Local concrete cracking, localized concrete spalling

DS2

Sequential

Extensive concrete cracking, concrete crushing

DS3

Sequential

Loss of live load capacity.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?	FLR	
Demand Location (floor above?)	No	

Illustrations



Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.00	1.00	1.00		
By User	By User	By User		
Not Specified	Not Specified	Not Specified		
Not Specified	Not Specified	Not Specified		
By User	By User	By User		

Marginal
Marginal
Average
Not Rated

Protect surrounding space, epoxy inject cracks, repair finishes. Modify or relocate mechanical and electrical as required for repair work. Repair finishes.

Protect floor, cut out damaged areas, repair buckled rebar, patch / cast concrete, repair finishes. Modify or relocate mechanical and electrical as required for repair work. Repair finishes.

Protect area, remove damaged stair including landings and handrails. Remove and reinstall damaged soffit and mechanical systems. Replace stair, landings, and handrail. Modify or relocate mechanical and electrical as required for repair work. Repair finishes.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.00E+02	7.00E+02	1.70E+03	1.80E+03	3.70E+03	7.70E+03	1.44E+04	2.50E+04	3.67E+04						
Best fit mean:	6.14E+02			3.71E+03			2.53E+04								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	8.40E+02 0.80			4.44E+03 0.57			2.99E+04 0.34			2.00E+04 0.34					
CV or beta (Min Qty, Max Qty)	0.80			0.57			0.34			0.34					
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.10E-01	7.72E-01	1.88E+00	1.99E+00	4.08E+00	8.49E+00	1.59E+01	2.75E+01	4.05E+01						
Best fit mean:	7.72E-01			4.08E+00			2.75E+01								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Time (Min Qty, Max Qty)	9.27E-01 0.84			4.90E+00 0.62			3.30E+01 0.42			2.20E+01 0.42					
CV or beta (Min Qty, Max Qty)	0.84			0.62			0.42			0.42					
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable								
Casualty-affected Planar Area (sf) per Normative Unit:	0%			0%			0%								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			25% 0.50			10% 0.50								

Comments:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

None

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

C2011.021c

Monolithic cast-in-place and precast concrete stairs with seismic joints that accommodate drift - replace with prefabricated steel stair if replacement is required.
Cast in place concrete stair, with seismic interstory drift joint

Line 367

Construction Quality: Normal

Seismic Installation Conditions: All

Fragility Unit of Measure: EA 1

Demand Parameter (unit): Story Drift Ratio Unit less

Number of Damage States: 3

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1,DS2,DS3)

Descriptions: Local concrete cracking, localized concrete spalling

DS2

Sequential

Extensive concrete cracking, concrete crushing

DS3

Sequential

Loss of live load capacity.

Quantity Rounding Round Qty? YES
Allow sum by floor or building? FLR
Demand Location (floor above?) No

Illustrations



Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.00

By User

Not Specified

Not Specified

By User

NO

YES

Marginal

Marginal

Average

Not Rated

Protect surrounding space, epoxy inject cracks, repair finishes. Modify or relocate mechanical and electrical as required for repair work. Repair finishes.

1.00

By User

Not Specified

Not Specified

By User

NO

YES

Marginal

Marginal

Average

Not Rated

Protect floor, cut out damaged areas, repair buckled rebar, patch / cast concrete, repair finishes. Modify or relocate mechanical and electrical as required for repair work. Repair finishes.

1.00

By User

Not Specified

Not Specified

By User

NO

YES

Marginal

Marginal

Average

Not Rated

Protect area, remove damaged stair including landings and handrails. Remove and reinstall damaged soffit and mechanical systems. Replace stair, landings, and handrail. Modify or relocate mechanical and electrical as required for repair work. Repair finishes.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.00E+02	7.00E+02	1.70E+03	1.80E+03	3.70E+03	7.70E+03	1.44E+04	2.50E+04	3.67E+04						
Best fit mean:	6.14E+02			3.71E+03			2.53E+04								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	9.10E+02 0.80			4.44E+03 0.57			2.99E+04 0.34								
CV or beta (Min Qty, Max Qty)	0.80			0.57			0.34								
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.10E-01	7.72E-01	1.88E+00	1.99E+00	4.08E+00	8.49E+00	1.59E+01	2.75E+01	4.05E+01						
Best fit mean:	7.72E-01			4.08E+00			2.75E+01								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Time (Min Qty, Max Qty)	1.00E+00 0.84			4.90E+00 0.62			3.30E+01 0.42								
CV or beta (Min Qty, Max Qty)	0.84			0.62			0.42								
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable								
Casualty-affected Planar Area (sf) per Normative Unit:	0%			0%			0%								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			25% 0.50			10% 0.50								

Comments: User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO)? By User

Author: Not Given

Revisions: None

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

C2011.021d

Monolithic cast-in-place and precast concrete stairs with no seismic joints - replace with prefabricated steel stair if replacement is required.
Cast in place concrete stair, no seismic interstory drift joint

Line 368

Construction Quality:	Normal			<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? FLR</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	All			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Story Drift Ratio	Unit less		
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	Local concrete cracking, localized concrete spalling	Extensive concrete cracking, concrete crushing	Loss of live load capacity.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?	FLR	
Demand Location (floor above?)	No	

Illustrations

				
C2011.011a-DS1-1.jpg	C2011.011a-DS2-1.jpg	C2011.011a-DS2-1.jpg		
1.00	1.00	1.00		

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	By User	By User	By User	
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified	
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified	
Total Dispersion, β :	By User	By User	By User	
Correlation (Yes / No)	NO			
Directionality (Yes / No)	YES			
Quality Ratings				
Data Quality	Marginal			
Data Relevance	Marginal			
Documentation Quality	Average			
Rationality	Not Rated			
Consequence Functions				
Repair Description				

Protect surrounding space, epoxy inject cracks, repair finishes. Modify or relocate mechanical and electrical as required for repair work. Repair finishes.

Protect floor, cut out damaged areas, repair buckled rebar, patch / cast concrete, repair finishes. Modify or relocate mechanical and electrical as required for repair work. Repair finishes.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.00E+02	7.00E+02	1.70E+03	1.80E+03	3.70E+03	7.70E+03	1.44E+04	2.50E+04	3.67E+04						
Best fit mean:	6.14E+02			3.71E+03			2.63E+04								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	8.40E+02 0.80			4.44E+03 0.57			2.99E+04 0.34			2.00E+04 0.34					
CV or beta (Min Qty, Max Qty)	0.80			0.57			0.34			0.34					
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.10E-01	7.72E-01	1.88E+00	1.99E+00	4.08E+00	8.49E+00	1.59E+01	2.75E+01	4.05E+01						
Best fit mean:	7.72E-01			4.08E+00			2.75E+01								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Time (Min Qty, Max Qty)	9.27E-01 0.84			4.90E+00 0.62			3.30E+01 0.42			2.20E+01 0.42					
CV or beta (Min Qty, Max Qty)	0.84			0.62			0.42			0.42					
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			25% 0.50			10% 0.50								

Comments: User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: None

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

C2011.031a

Hybrid stair assembly with steel stringers and concrete treads and landings with seismic joints that accommodate drift.
Stair consists of steel stringers with precast treads rigidly linked to stringer

Line 369

Construction Quality:	Normal				<div>Quantity Rounding</div> <div>Round Qty? YES</div> <div>Allow sum by floor or building? FLR</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	All				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Localized steel yielding.	Buckling of steel, weld cracking.	Loss of live load capacity.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?	FLR	
Demand Location (floor above?)	No	

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	By User	By User	By User	
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified	
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified	
Total Dispersion, β :	By User	By User	By User	

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Marginal
Data Relevance Marginal
Documentation Quality Average
Rationality Not Rated
Consequence Functions

Repair Description
Protect surrounding space. Minor repair of finishes. Modify or relocate mechanical and electrical as required for repair work. Repair finishes.
Protect floor, cut out damaged areas, reweld. Repair finishes. Modify or relocate mechanical and electrical as required for repair work. Repair finishes.
Protect area, remove damaged stair including landings and handrails. Remove and reinstall damaged soffit and mechanical systems. Replace stair, landings, and handrail. Modify or relocate mechanical and electrical as required for repair work. Repair finishes.

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.00E+02	4.00E+02	1.40E+03	1.30E+03	2.70E+03	5.70E+03	1.08E+04	2.10E+04	3.15E+04						
Best fit mean:	3.94E+02			2.71E+03			2.11E+04								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	4.80E+02 0.99			3.24E+03 0.58			2.51E+04 0.38			1.68E+04 0.38					
CV or beta (Min Qty, Max Qty)	0.99			0.58			0.38			0.38					
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.10E-01	4.41E-01	1.54E+00	1.43E+00	2.98E+00	6.29E+00	1.19E+01	2.31E+01	3.47E+01						
Best fit mean:	4.41E-01			2.98E+00			2.31E+01								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Time (Min Qty, Max Qty)	5.29E-01 1.02			3.57E+00 0.63			2.77E+01 0.46			1.85E+01 0.46					
CV or beta (Min Qty, Max Qty)	1.02			0.63			0.46			0.46					
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:	NO			NO			NO								
Potential non-collapse casualties? (Yes / No)	Not Applicable			Not Applicable			Not Applicable								
Casualty-affected Planar Area (sf) per Normative Unit:	0%			0%			0%								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			25% 0.50			10% 0.50								

Comments: User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: None
Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification C2011.031b
NISTIR Name Hybrid stair assembly with steel stringers and concrete treads and landings with no seismic joints.
Description Stair consists of steel stringers with precast treads rigidly linked to stringer

Line 370

Construction Quality:	Normal				<div>Quantity Rounding</div> <div>Round Qty? YES</div> <div>Allow sum by floor or building? FLR</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	All				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	Localized steel yielding.	Buckling of steel, weld cracking.	Loss of live load capacity.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?	FLR	
Demand Location (floor above?)	No	

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		

Fragility Parameters					
Median Demand, θ :	0.005	0.017	0.028		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	0.6	0.6	0.45		

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Marginal
Data Relevance Marginal
Documentation Quality Average
Rationality Not Rated
Consequence Functions

Repair Description
Protect surrounding space. Minor repair of finishes. Modify or relocate mechanical and electrical as required for repair work. Repair finishes.
Protect floor, cut out damaged areas, reweld. Repair finishes. Modify or relocate mechanical and electrical as required for repair work. Repair finishes.
Protect area, remove damaged stair including landings and handrails. Remove and reinstall damaged soffit and mechanical systems. Replace stair, landings, and handrail. Modify or relocate mechanical and electrical as required for repair work. Repair finishes.

Long Lead Time (Yes / No) NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.00E+02	4.00E+02	1.40E+03	1.30E+03	2.70E+03	5.70E+03	1.08E+04	2.10E+04	3.15E+04						
Best fit mean:	3.94E+02			2.71E+03			2.11E+04								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Cost (Min Qty, Max Qty)	4.80E+02			3.24E+03			2.16E+03			2.51E+04 1.68E+04					
CV or beta (Min Qty, Max Qty)	0.99			0.58			0.58			0.38 0.38					
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.26E-02	3.71E-01	1.30E+00	1.20E+00	2.50E+00	5.28E+00	1.00E+01	1.94E+01	2.92E+01						
Best fit mean:	3.71E-01			2.50E+00			1.94E+01								
Best Fit Distribution:	LogNormal			LogNormal			Normal								
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00			3.00 10.00								
Average Repair Time (Min Qty, Max Qty)	4.45E-01			2.96E-01			3.00E+00 2.00E+00			2.33E+01 1.55E+01					
CV or beta (Min Qty, Max Qty)	1.02			1.02			0.63 0.63			0.46 0.46					
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00								
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			25% 0.50			10% 0.50								
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														
	Root Cost Multiplier: 1														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR ClassificationC3011.001a

NISTIR NameDescription

Wall Partition, Type: Gypsum + Wallpaper, Full Height, Fixed Below, Fixed Above

Costing based upon 9'x100' Panels

Line 371

Construction Quality:Normal

Seismic Installation Conditions:Not Specified

Fragility Unit of Measure:LF 100

Demand Parameter (unit):Story Drift RatioUnit less

Number of Damage States:1

Damage State:DS1

Type of Damage State:Sequential

DS HierarchySeq(DS1)

DescriptionsWall paper warped and torn.

Quantity RoundingRound Qty?NO

Allow sum by floor or building?NO

Demand Location (floor above?)No

Illustrations					
	none				
Damage State Probability:	1.00				

Fragility Parameters

Median Demand, θ :0.0021

Data dispersion, β_d :Not Specified

Uncertainty, β_u :Not Specified

Total Dispersion, β :0.6

Correlation (Yes / No)NO

Directionality (Yes / No)YES

Quality Ratings

Data QualitySuperior

Data RelevanceSuperior

Documentation QualitySuperior

RationalityNot Rated

Consequence Functions

Repair DescriptionRemove existing wall paper (or wall) and install new wall paper for full 100 foot length of wall. Existing wall damage per wall type NISTIR file.

Long Lead Time (Yes / No)NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.40E+03	2.70E+03	3.50E+03												
Best fit mean:	2.40E+03	2.70E+03	3.50E+03												
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		3.00												
Average Repair Cost (Min Qty, Max Qty)	3.24E+03		2.16E+03												
CV or beta (Min Qty, Max Qty)	0.15		0.15												
Quantity Unit:	Each (9'x100' Panel)														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.25E+00	2.52E+00	3.24E+00												
Best fit mean:	2.25E+00	2.52E+00	3.24E+00												
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		3.00												
Average Repair Time (Min Qty, Max Qty)	3.02E+00		2.02E+00												
CV or beta (Min Qty, Max Qty)	0.29		0.29												
Quantity Unit:	Each (9'x100' Panel)														
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														

Root Cost Multiplier:900

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

C3011.001b
Wall Partition, Type: Gypsum + Wallpaper, Partial Height, Fixed Below, Lateral Braced Above
Costing based upon 9'x100' Panels

Line 372

Construction Quality: Normal

Seismic Installation Conditions: Not Specified

Fragility Unit of Measure: LF 100

Demand Parameter (unit): Story Drift Ratio Unit less

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1)

Descriptions: Wall paper warped and torn.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO

No

Illustrations					
	none				
	1.00				

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

0.0064
Not Specified
Not Specified
0.3
NO
YES
Superior
Superior
Superior
Not Rated
Remove existing wall paper (or wall) and install new wall paper for full 100 foot length of wall. Existing wall damage per wall type NISTIR file.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.40E+03	2.70E+03	3.50E+03												
Best fit mean:	2.83E+03														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		3.00												
Average Repair Cost (Min Qty, Max Qty)	3.24E+03		2.16E+03												
CV or beta (Min Qty, Max Qty)	0.15		0.15												
Quantity Unit:	Each (9'x100' Panel)														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.25E+00	2.52E+00	3.24E+00												
Best fit mean:	2.52E+00														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		3.00												
Average Repair Time (Min Qty, Max Qty)	3.02E+00		2.02E+00												
CV or beta (Min Qty, Max Qty)	0.29		0.29												
Quantity Unit:	Each (9'x100' Panel)														
LifeSafety Hazard:	NO														
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														

Root Cost Multiplier: 900

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

C3011.001c

Wall Partition, Type: Gypsum + Wallpaper, Full Height, Fixed Below, Slip Track Above w/ returns (friction connection)

Costing based upon 9'x100' Panels

Line 373

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

No

Construction Quality:

Normal

Seismic Installation Conditions:

Not Specified

Fragility Unit of Measure:

LF 100

Demand Parameter (unit):

Story Drift Ratio

Unit less

Number of Damage States:

1

Damage State:

DS1

Type of Damage State:

Sequential

DS Hierarchy

Seq(DS1)

Descriptions

Wall paper warped and torn.

Illustrations

none

1.00

0.002

Not Specified

Not Specified

0.7

NO

YES

Superior

Superior

Superior

Not Rated

Remove existing wall paper (or wall) and install new wall paper for full 100 foot length of wall. Existing wall damage per wall type NISTIR file.

Damage State Probability:

1.00

Fragility Parameters

Median Demand, θ :

0.002

Data dispersion, β_d :

Not Specified

Uncertainty, β_u :

Not Specified

Total Dispersion, β :

0.7

Correlation (Yes / No)

NO

Directionality (Yes / No)

YES

Quality Ratings

Data Quality

Superior

Data Relevance

Superior

Documentation Quality

Superior

Rationality

Not Rated

Consequence Functions

Repair Description

Remove existing wall paper (or wall) and install new wall paper for full 100 foot length of wall. Existing wall damage per wall type NISTIR file.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

2.40E+03

2.70E+03

3.50E+03

Best fit mean:

2.83E+03

Best Fit Distribution:

LogNormal

Quantity Plateau (Min Qty, Max Qty)

1.00

3.00

Average Repair Cost (Min Qty, Max Qty)

3.24E+03

2.16E+03

CV or beta (Min Qty, Max Qty)

0.15

0.15

Quantity Unit:

Each (9'x100' Panel)

Repair Time:

Repair Time by Damage State:

2.25E+00

2.52E+00

3.24E+00

Best fit mean:

2.52E+00

Best Fit Distribution:

LogNormal

Quantity Plateau (Min Qty, Max Qty)

1.00

3.00

Average Repair Time (Min Qty, Max Qty)

3.02E+00

2.02E+00

CV or beta (Min Qty, Max Qty)

0.29

0.29

Quantity Unit:

Each (9'x100' Panel)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

NO

Casualty-affected Planar Area (sf) per Normative Unit:

Not Applicable

Serious Injury (Median, Dispersion)

0%

0.00

Loss of Life (Median, Dispersion)

0%

0.00

Post-event Tagging Flag:

NO

Unsafe Placard Trigger (Median, Dispersion)

0%

0.00

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

None

Root Cost Multiplier:

900

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

C3011.001d

Wall Partition, Type: Gypsum + Wallpaper, Full Height, Fixed Below, Slip Track Above w/o returns (friction connection)
Costing based upon 9'x100' Panels

Line 374

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

Not Specified

LF 100

Story Drift Ratio

Unit less

1

DS1

Sequential

Seq(DS1)

Wall paper warped and torn.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO

No

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

0.0035

Not Specified

Not Specified

0.7

NO

YES

Superior

Superior

Superior

Not Rated

Remove existing wall paper (or wall) and install new wall paper for full 100 foot length of wall. Existing wall damage per wall type NISTIR file.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Each (9'x100' Panel)

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Each (9'x100' Panel)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

2.40E+03

2.70E+03

3.50E+03

LogNormal

1.00

3.00

3.24E+03

2.16E+03

0.15

0.15

Each (9'x100' Panel)

2.25E+00

2.52E+00

3.24E+00

2.52E+00

LogNormal

1.00

3.00

3.02E+00

2.02E+00

0.29

0.29

Each (9'x100' Panel)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

900

FEMA P-58 Fragility Specification

NISTIR ClassificationC3011.002b

NISTIR NameDescription

Wall Partition, Type: Gypsum + Ceramic Tile, Partial Height, Fixed Below, Lateral Braced Above

Costing based upon 9'x100' Panels

Line 376

Construction Quality:	Normal				
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	LF 100				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	2				
Damage State:	DS1		DS2		
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Minor cracked joints and tile.		Cracked joints and tile.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none	none			
Damage State Probability:	1.00	1.00			

Fragility Parameters					
Median Demand, θ :	0.0064	0.011			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.3	0.3			

Correlation (Yes / No) NO
Directionality (Yes / No) YES

Quality Ratings
Data Quality Superior
Data Relevance Superior
Documentation Quality Superior
Rationality Not Rated

Consequence Functions
Repair Description
Carefully remove cracked tile and grout at cracked joints, install new ceramic tile and re-grout joints for 10% of full 100 foot length of wall. Existing wall board will remain in place.
Install ceramic tile and grout all joints for full 100 foot length of wall. Note: gypsum wall board will also be removed and replaced which means the removal of ceramic tile will be part of the gypsum wall board removal.

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	5.00E+03	7.20E+03	9.00E+03	2.70E+04	2.92E+04	3.42E+04									
Best fit mean:	7.07E+03			3.00E+04											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		3.00	1.00		3.00									
Average Repair Cost (Min Qty, Max Qty)	8.64E+03		5.76E+03	3.50E+04		2.33E+04									
CV or beta (Min Qty, Max Qty)	0.22		0.22	0.09		0.09									
Quantity Unit:	Each (9'x100' Panel)			Each (9'x100' Panel)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	4.59E+00	6.66E+00	8.37E+00	2.50E+01	2.70E+01	3.17E+01									
Best fit mean:	6.66E+00			2.70E+01											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		3.00	1.00		3.00									
Average Repair Time (Min Qty, Max Qty)	7.99E+00		5.33E+00	3.24E+01		2.16E+01									
CV or beta (Min Qty, Max Qty)	0.33		0.33	0.27		0.27									
Quantity Unit:	Each (9'x100' Panel)			Each (9'x100' Panel)											
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00									
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00									
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	0%		0.00									

Root Cost Multiplier: 900

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

C3011.002c

Wall Partition, Type: Gypsum + Ceramic Tile, Full Height, Fixed Below, Slip Track Above w/ returns (friction connection)
Costing based upon 9'x100' Panels

Line 377

Construction Quality:	Normal				
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	LF 100				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	2				
Damage State:	DS1		DS2		
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Minor cracked joints and tile.		Cracked joints and tile.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	No	

Illustrations

none	none			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.002	0.005			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.7	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Superior				
Data Relevance	Superior				
Documentation Quality	Superior				
Rationality	Not Rated				
Consequence Functions					
Repair Description					

Carefully remove cracked tile and grout at cracked joints, install new ceramic tile and re-grout joints for 10% of full 100 foot length of wall. Existing wall board will remain in place.

Install ceramic tile and grout all joints for full 100 foot length of wall. Note: gypsum wall board will also be removed and replaced which means the removal of ceramic tile will be part of the gypsum wall board removal.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	5.00E+03	7.20E+03	9.00E+03	2.70E+04	2.92E+04	3.42E+04									
Best fit mean:	7.07E+03			3.00E+04											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00	3.00		1.00	3.00										
Average Repair Cost (Min Qty, Max Qty)	8.64E+03	5.76E+03		3.50E+04	2.33E+04										
CV or beta (Min Qty, Max Qty)	0.22	0.22		0.09	0.09										
Quantity Unit:	Each (9'x100' Panel)			Each (9'x100' Panel)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	4.59E+00	6.66E+00	8.37E+00	2.50E+01	2.70E+01	3.17E+01									
Best fit mean:	6.66E+00			2.70E+01											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00	3.00		1.00	3.00										
Average Repair Time (Min Qty, Max Qty)	7.99E+00	5.33E+00		3.24E+01	2.16E+01										
CV or beta (Min Qty, Max Qty)	0.33	0.33		0.27	0.27										
Quantity Unit:	Each (9'x100' Panel)			Each (9'x100' Panel)											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										

Root Cost Multiplier: 900

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

C3011.002d

Wall Partition, Type: Gypsum + Ceramic Tile, Full Height, Fixed Below, Slip Track Above w/o returns (friction connection)
Costing based upon 9'x100' Panels

Line 378

Construction Quality:	Normal				
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	LF 100				
Demand Parameter (unit):	Story Drift Ratio		Unit less		
Number of Damage States:	2				
Damage State:	DS1		DS2		
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Minor cracked joints and tile.		Cracked joints and tile.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	No	

Illustrations

none	none			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.0035	0.0093			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.7	0.45			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Superior				
Data Relevance	Superior				
Documentation Quality	Superior				
Rationality	Not Rated				
Consequence Functions					
Repair Description					

Carefully remove cracked tile and grout at cracked joints, install new ceramic tile and re-grout joints for 10% of full 100 foot length of wall. Existing wall board will remain in place.

Install ceramic tile and grout all joints for full 100 foot length of wall. Note: gypsum wall board will also be removed and replaced which means the removal of ceramic tile will be part of the gypsum wall board removal.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	5.00E+03	7.20E+03	9.00E+03	2.70E+04	2.92E+04	3.42E+04									
Best fit mean:	7.07E+03			3.00E+04											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00	3.00		1.00	3.00										
Average Repair Cost (Min Qty, Max Qty)	8.64E+03	5.76E+03		3.50E+04	2.33E+04										
CV or beta (Min Qty, Max Qty)	0.22	0.22		0.09	0.09										
Quantity Unit:	Each (9'x100' Panel)			Each (9'x100' Panel)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	4.59E+00	6.66E+00	8.37E+00	2.50E+01	2.70E+01	3.17E+01									
Best fit mean:	6.66E+00			2.70E+01											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00	3.00		1.00	3.00										
Average Repair Time (Min Qty, Max Qty)	7.99E+00	5.33E+00		3.24E+01	2.16E+01										
CV or beta (Min Qty, Max Qty)	0.33	0.33		0.27	0.27										
Quantity Unit:	Each (9'x100' Panel)			Each (9'x100' Panel)											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										

Root Cost Multiplier: 900

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

C3011.003a

Wall Partition, Type: High End Marble or Wood Panel, Full Height, Fixed Below, Fixed Above
Costing based upon 9'x100' Panels

Line 379

Construction Quality:	Normal					<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	LF 100					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	minor cracked joints and minor cracks in marble / wood paneling.		significant cracks in marble / wood paneling.			

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

none	none			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.0021	0.0071			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.6	0.45			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Superior				
Data Relevance	Superior				
Documentation Quality	Superior				
Rationality	Not Rated				
Consequence Functions					
Repair Description					

Carefully remove cracked marble/paneling and grout at cracked joints, and install new marble/paneling and re-grout joints for 10% of full 100 foot length of wall. Existing wall board will remain place.

Install new marble/paneling for full 100 foot length of wall. Note: the gypsum wall board will also be removed and replaced which means the removal of the marble/paneling will be part of the gypsum wall board removal.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.20E+04	1.80E+04	2.40E+04	2.50E+04	4.50E+04	6.00E+04									
Best fit mean:	1.80E+04			4.33E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	1.00		3.00	1.00		3.00									
Average Repair Cost (Min Qty, Max Qty)	3.60E+04		1.08E+04	9.00E+04		2.70E+04									
CV or beta (Min Qty, Max Qty)	0.26		0.26	0.32		0.32									
Quantity Unit:	Each (9'x100' Panel)			Each (9'x100' Panel)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.12E+01	1.67E+01	2.22E+01	2.31E+01	4.17E+01	5.56E+01									
Best fit mean:	1.67E+01			4.17E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	1.00		3.00	1.00		3.00									
Average Repair Time (Min Qty, Max Qty)	3.33E+01		9.98E+00	8.34E+01		2.50E+01									
CV or beta (Min Qty, Max Qty)	0.36		0.36	0.40		0.40									
Quantity Unit:	Each (9'x100' Panel)			Each (9'x100' Panel)											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			100 SF											
Serious Injury (Median, Dispersion)	0%	0.00		10%	0.50										
Loss of Life (Median, Dispersion)	0%	0.00		5%	0.50										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		50%	0.50										
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														
							Root Cost Multiplier: 900								

Root Cost Multiplier: 900

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

C3011.003b

Wall Partition, Type: High End Marble or Wood Panel, Partial Height, Fixed Below, Lateral Braced Above
Costing based upon 9'x100' Panels

Line 380

Construction Quality:	Normal					<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	LF 100					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	minor cracked joints and minor cracks in marble / wood paneling.		significant cracks in marble / wood paneling.			

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	No	

Illustrations

none	none			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.0064	0.011			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.3	0.3			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Superior				
Data Relevance	Superior				
Documentation Quality	Superior				
Rationality	Not Rated				
Consequence Functions					
Repair Description					

Carefully remove cracked marble/paneling and grout at cracked joints, and install new marble/paneling and re-grout joints for 10% of full 100 foot length of wall. Existing wall board will remain place.

Install new marble/paneling for full 100 foot length of wall. Note: the gypsum wall board will also be removed and replaced which means the removal of the marble/paneling will be part of the gypsum wall board removal.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀						
Repair Cost by Damage State:	1.20E+04	1.80E+04	2.40E+04	2.50E+04	4.50E+04	6.00E+04															
Best fit mean:	1.80E+04			4.33E+04																	
Best Fit Distribution:	Normal			Normal																	
Quantity Plateau (Min Qty, Max Qty)	1.00		3.00	1.00		3.00															
Average Repair Cost (Min Qty, Max Qty)	3.60E+04		1.08E+04	9.00E+04		2.70E+04															
CV or beta (Min Qty, Max Qty)	0.26		0.26	0.32		0.32															
Quantity Unit:	Each (9'x100' Panel)			Each (9'x100' Panel)																	
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀						
Repair Time by Damage State:	1.12E+01	1.67E+01	2.22E+01	2.31E+01	4.17E+01	5.56E+01															
Best fit mean:	1.67E+01			4.17E+01																	
Best Fit Distribution:	Normal			Normal																	
Quantity Plateau (Min Qty, Max Qty)	1.00		3.00	1.00		3.00															
Average Repair Time (Min Qty, Max Qty)	3.33E+01		9.98E+00	8.34E+01		2.50E+01															
CV or beta (Min Qty, Max Qty)	0.36		0.36	0.40		0.40															
Quantity Unit:	Each (9'x100' Panel)			Each (9'x100' Panel)																	
LifeSafety Hazard:																					
Potential non-collapse casualties? (Yes / No)	NO					YES															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable					100 SF															
Serious Injury (Median, Dispersion)	0%	0.00		10%	0.50																
Loss of Life (Median, Dispersion)	0%	0.00		5%	0.50																
Post-event Tagging Flag:	NO					YES															
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		50%	0.50																
Comments:	None																				
Date Created:	Not Given																				
Approved (YES / NO)?	By User																				
Official (YES / NO) ?	By User																				
Author:	Not Given																				
Revisions:	None																				

Root Cost Multiplier: 900

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

C3011.003c

Wall Partition, Type: High End Marble or Wood Panel, Full Height, Fixed Below, Slip Track Above w/ returns (friction connection)
Costing based upon 9'x100' Panels

Line 381

Construction Quality:	Normal					<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	LF 100					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	minor cracked joints and minor cracks in marble / wood paneling.		significant cracks in marble / wood paneling.			

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	No	

Illustrations

none	none			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.002	0.005			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.7	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Superior				
Data Relevance	Superior				
Documentation Quality	Superior				
Rationality	Not Rated				
Consequence Functions					
Repair Description					

Carefully remove cracked marble/paneling and grout at cracked joints, and install new marble/paneling and re-grout joints for 10% of full 100 foot length of wall. Existing wall board will remain place.

Install new marble/paneling for full 100 foot length of wall. Note: the gypsum wall board will also be removed and replaced which means the removal of the marble/paneling will be part of the gypsum wall board removal.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀						
Repair Cost by Damage State:	1.20E+04	1.80E+04	2.40E+04	2.50E+04	4.50E+04	6.00E+04															
Best fit mean:	1.80E+04			4.33E+04																	
Best Fit Distribution:	Normal			Normal																	
Quantity Plateau (Min Qty, Max Qty)	1.00		3.00	1.00		3.00															
Average Repair Cost (Min Qty, Max Qty)	3.60E+04		1.08E+04	9.00E+04		2.70E+04															
CV or beta (Min Qty, Max Qty)	0.26		0.26	0.32		0.32															
Quantity Unit:	Each (9'x100' Panel)			Each (9'x100' Panel)																	
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀						
Repair Time by Damage State:	1.12E+01	1.67E+01	2.22E+01	2.31E+01	4.17E+01	5.56E+01															
Best fit mean:	1.67E+01			4.17E+01																	
Best Fit Distribution:	Normal			Normal																	
Quantity Plateau (Min Qty, Max Qty)	1.00		3.00	1.00		3.00															
Average Repair Time (Min Qty, Max Qty)	3.33E+01		9.98E+00	8.34E+01		2.50E+01															
CV or beta (Min Qty, Max Qty)	0.36		0.36	0.40		0.40															
Quantity Unit:	Each (9'x100' Panel)			Each (9'x100' Panel)																	
LifeSafety Hazard:																					
Potential non-collapse casualties? (Yes / No)	NO			YES																	
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			100 SF																	
Serious Injury (Median, Dispersion)	0%	0.00		10%	0.50																
Loss of Life (Median, Dispersion)	0%	0.00		5%	0.50																
Post-event Tagging Flag:	NO			YES																	
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		50%	0.50																
Comments:	None																				
Date Created:	Not Given																				
Approved (YES / NO)?	By User																				
Official (YES / NO) ?	By User																				
Author:	Not Given																				
Revisions:	None																				

Root Cost Multiplier: 900

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

C3011.003d

Wall Partition, Type: High End Marble or Wood Panel, Full Height, Fixed Below, Slip Track Above w/o returns (friction connection)
Costing based upon 9'x100' Panels

Line 382

Construction Quality:	Normal					<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Not Specified					
Fragility Unit of Measure:	LF 100					
Demand Parameter (unit):	Story Drift Ratio		Unit less			
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	minor cracked joints and minor cracks in marble / wood paneling.		significant cracks in marble / wood paneling.			

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	NO
Demand Location (floor above?)	No	

Illustrations

none	none			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.0035	0.0093			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.7	0.45			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	YES				
Quality Ratings					
Data Quality	Superior				
Data Relevance	Superior				
Documentation Quality	Superior				
Rationality	Not Rated				
Consequence Functions					
Repair Description					

Carefully remove cracked marble/paneling and grout at cracked joints, and install new marble/paneling and re-grout joints for 10% of full 100 foot length of wall. Existing wall board will remain place.

Install new marble/paneling for full 100 foot length of wall. Note: the gypsum wall board will also be removed and replaced which means the removal of the marble/paneling will be part of the gypsum wall board removal.

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.20E+04	1.80E+04	2.40E+04	2.50E+04	4.50E+04	6.00E+04									
Best fit mean:	1.80E+04			4.33E+04											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	1.00		3.00	1.00		3.00									
Average Repair Cost (Min Qty, Max Qty)	3.60E+04		1.08E+04	9.00E+04		2.70E+04									
CV or beta (Min Qty, Max Qty)	0.26		0.26	0.32		0.32									
Quantity Unit:	Each (9'x100' Panel)			Each (9'x100' Panel)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.12E+01	1.67E+01	2.22E+01	2.31E+01	4.17E+01	5.56E+01									
Best fit mean:	1.67E+01			4.17E+01											
Best Fit Distribution:	Normal			Normal											
Quantity Plateau (Min Qty, Max Qty)	1.00		3.00	1.00		3.00									
Average Repair Time (Min Qty, Max Qty)	3.33E+01		9.98E+00	8.34E+01		2.50E+01									
CV or beta (Min Qty, Max Qty)	0.36		0.36	0.40		0.40									
Quantity Unit:	Each (9'x100' Panel)			Each (9'x100' Panel)											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			100 SF											
Serious Injury (Median, Dispersion)	0%	0.00		10%	0.50										
Loss of Life (Median, Dispersion)	0%	0.00		5%	0.50										
Post-event Tagging Flag:	NO			YES											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		50%	0.50										

Root Cost Multiplier: 900

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

C3021.001a

Generic Floor Covering - Flooding of floor caused by failure of pipe - Office - Dry

The user needs to review the fragilities of all piping modeled in the ceiling of the floor and input the peak floor acceleration value for the pipe with the lowest median peak floor acceleration value, along with the associated total dispersion (beta). Flooding type assumed to be carpet or vinyl. Available costs are per one square foot of floor area.

Line 383

Construction Quality:	Normal
Seismic Installation Conditions:	Not Specified
Fragility Unit of Measure:	By User
Demand Parameter (unit):	Peak Floor Acceleration g
Number of Damage States:	1
Damage State:	DS1
Type of Damage State:	Sequential
DS Hierarchy	Seq(DS1)
Descriptions	Flooding of all or a portion of the total floor associated with a major leakage of a pipe.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations					
	none				
	1.00				

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	By User				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	By User				
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Replace or dry out of the affected flooring materials, equipment and contents. Remove areas that could be affected by mold. Potentially considerable downtime. Cleanup and replacement of all water damaged items on floor. User must establish area of floor with flooding. Default recommendation is flooding of total floor area. Damage to unit floor area shall be entered to consequence which is multiplied by PACT "Fragility Unit of Measure".				

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.84E+01	3.10E+01	4.03E+01												
Best fit mean:	2.99E+01														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00		2000.00												
Average Repair Cost (Min Qty, Max Qty)	6.21E+01		1.86E+01												
CV or beta (Min Qty, Max Qty)	0.28		0.28												
Quantity Unit:	Each (1'x1')														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.71E-02	2.88E-02	3.73E-02												
Best fit mean:	2.88E-02														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00		2000.00												
Average Repair Time (Min Qty, Max Qty)	5.76E-02		1.73E-02												
CV or beta (Min Qty, Max Qty)	0.38		0.38												
Quantity Unit:	Each (1'x1')														
LifeSafety Hazard:	NO														
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	2015-07-28 User must replace median and total dispersion (beta) associated with fragility of major piping. Made consequence generic for user specification according to particulars of structure.														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

C3021.001b

Generic Floor Covering - Flooding of floor caused by failure of pipe - Office - Humid

The user needs to review the fragilities of all piping modeled in the ceiling of the floor and input the peak floor acceleration value for the pipe with the lowest median peak floor acceleration value, along with the associated total dispersion (beta). Flooring type assumed to be carpet or vinyl. Available costs are per one square foot of floor area.

Line 384

Construction Quality:	Normal
Seismic Installation Conditions:	Not Specified
Fragility Unit of Measure:	By User
Demand Parameter (unit):	Peak Floor Acceleration g
Number of Damage States:	1
Damage State:	DS1
Type of Damage State:	Sequential
DS Hierarchy	Seq(DS1)
Descriptions	Flooding of all or a portion of the total floor associated with a major leakage of a pipe.

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations					
	none				

Damage State Probability:	1.00				
Fragility Parameters					
Median Demand, θ :	By User				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	By User				
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Replace or dry out of the affected flooring materials, equipment and contents. Remove areas that could be affected by mold. Potentially considerable downtime. Cleanup and replacement of all water damaged items on floor. User must establish area of floor with flooding. Default recommendation is flooding of total floor area. Damage to unit floor area shall be entered to consequence which is multiplied by PACT "Fragility Unit of Measure".				

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.62E+01	5.32E+01	7.15E+01												
Best fit mean:	5.37E+01														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00		2000.00												
Average Repair Cost (Min Qty, Max Qty)	1.06E+02		3.19E+01												
CV or beta (Min Qty, Max Qty)	0.26		0.26												
Quantity Unit:	Each (1'x1')														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.35E-02	4.93E-02	6.63E-02												
Best fit mean:	4.93E-02														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00		2000.00												
Average Repair Time (Min Qty, Max Qty)	9.86E-02		2.96E-02												
CV or beta (Min Qty, Max Qty)	0.36		0.36												
Quantity Unit:	Each (1'x1')														
LifeSafety Hazard:	NO														
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	2015-07-28 Made consequence generic for user specification according to particulars of structure.														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

C3021.001c

Generic Floor Covering - Flooding of floor caused by failure of pipe - Laboratory - Dry
The user needs to review the fragilities of all piping modeled in the ceiling of the floor and input the peak floor acceleration value for the pipe with the lowest median peak floor acceleration value, along with the associated total dispersion (beta). Flooding type assumed to be sheet vinyl. Available costs are per one square foot of floor area.

Line 385

Construction Quality: Normal

Seismic Installation Conditions: Not Specified

Fragility Unit of Measure: By User

Demand Parameter (unit): Peak Floor Acceleration g

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1)

Descriptions: Flooding of all or a portion of the total floor associated with a major leakage of a pipe.

Quantity Rounding

Round Qty? NO

Allow sum by floor or building? NO

Demand Location (floor above?) Yes

Illustrations

none				
1.00				

Damage State Probability:

Fragility Parameters

Median Demand, θ : By User

Data dispersion, β_d : Not Specified

Uncertainty, β_u : Not Specified

Total Dispersion, β : By User

Correlation (Yes / No): NO

Directionality (Yes / No): NO

Quality Ratings

Data Quality: Not Rated

Data Relevance: Not Rated

Documentation Quality: Not Rated

Rationality: Not Rated

Consequence Functions

Repair Description: Replace or dry out of the affected flooring materials, equipment and contents. Remove areas that could be affected by mold. Potentially considerable downtime. Cleanup and replacement of all water damaged items on floor. User must establish area of floor with flooding. Default recommendation is flooding of total floor area. Damage to unit floor area shall be entered to consequence which is multiplied by PACT "Fragility Unit of Measure".

Long Lead Time (Yes / No) NO

Repair Costs:

Repair Cost by Damage State:

P ₁₀	P ₅₀	P ₉₀
2.34E+01	4.43E+01	5.65E+01

Best fit mean: 4.14E+01

Best Fit Distribution: Normal

Quantity Plateau (Min Qty, Max Qty): 500.00 2000.00

Average Repair Cost (Min Qty, Max Qty): 8.85E+01 2.66E+01

CV or beta (Min Qty, Max Qty): 0.31 0.31

Quantity Unit: Each (1'x1')

Repair Time:

Repair Time by Damage State:

P ₁₀	P ₅₀	P ₉₀
2.17E-02	4.10E-02	5.23E-02

Best fit mean: 4.10E-02

Best Fit Distribution: Normal

Quantity Plateau (Min Qty, Max Qty): 500.00 2000.00

Average Repair Time (Min Qty, Max Qty): 8.20E-02 2.46E-02

CV or beta (Min Qty, Max Qty): 0.40 0.40

Quantity Unit: Each (1'x1')

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No): NO

Casualty-affected Planar Area (sf) per Normative Unit: Not Applicable

Serious Injury (Median, Dispersion): 0% 0.00

Loss of Life (Median, Dispersion): 0% 0.00

Post-event Tagging Flag: NO

Unsafe Placard Trigger (Median, Dispersion): 0% 0.00

Comments: None

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: 2015-07-28 Made consequence generic for user specification according to particulars of structure.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

C3021.001d

Generic Floor Covering - Flooding of floor caused by failure of pipe - Laboratory - Humid

The user needs to review the fragilities of all piping modeled in the ceiling of the floor and input the peak floor acceleration value for the pipe with the lowest median peak floor acceleration value, along with the associated total dispersion (beta). Flooding type assumed to be sheet vinyl. Available costs are per one square foot of floor area.

Line 386

Construction Quality:	Normal
Seismic Installation Conditions:	Not Specified
Fragility Unit of Measure:	By User
Demand Parameter (unit):	Peak Floor Acceleration g
Number of Damage States:	1
Damage State:	DS1
Type of Damage State:	Sequential
DS Hierarchy	Seq(DS1)
Descriptions	Flooding of all or a portion of the total floor associated with a major leakage of a pipe.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations					
	none				
Damage State Probability:	1.00				

Fragility Parameters					
Median Demand, θ :	By User				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	By User				
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Replace or dry out of the affected flooring materials, equipment and contents. Remove areas that could be affected by mold. Potentially considerable downtime. Cleanup and replacement of all water damaged items on floor. User must establish area of floor with flooding. Default recommendation is flooding of total floor area. Damage to unit floor area shall be entered to consequence which is multiplied by PACT "Fragility Unit of Measure".				

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	6.86E+01	1.01E+02	1.36E+02												
Best fit mean:	1.02E+02														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00		2000.00												
Average Repair Cost (Min Qty, Max Qty)	2.02E+02		6.05E+01												
CV or beta (Min Qty, Max Qty)	0.26		0.26												
Quantity Unit:	Each (1'x1')														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.36E-02	9.34E-02	1.26E-01												
Best fit mean:	9.34E-02														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00		2000.00												
Average Repair Time (Min Qty, Max Qty)	1.87E-01		5.60E-02												
CV or beta (Min Qty, Max Qty)	0.36		0.36												
Quantity Unit:	Each (1'x1')														
LifeSafety Hazard:	NO														
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	2015-07-28 Made consequence generic for user specification according to particulars of structure.														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

C3021.001e

Generic Floor Covering - Flooding of floor caused by failure of pipe - Hospital - Dry
The user needs to review the fragilities of all piping modeled in the ceiling of the floor and input the peak floor acceleration value for the pipe with the lowest median peak floor acceleration value, along with the associated total dispersion (beta). Flooding type assumed to be sheet vinyl. Available costs are per one square foot of floor area.

Line 387

Construction Quality:	Normal	
Seismic Installation Conditions:	Not Specified	
Fragility Unit of Measure:	By User	
Demand Parameter (unit):	Peak Floor Acceleration	g
Number of Damage States:	1	
Damage State:	DS1	
Type of Damage State:	Sequential	
DS Hierarchy	Seq(DS1)	
Descriptions	Flooding of all or a portion of the total floor associated with a major leakage of a pipe.	

Quantity RoundingRound Qty?NOAllow sum by floor or building?NODemand Location (floor above?)Yes

Illustrations

none				
1.00				

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	By User				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	By User				
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Replace or dry out of the affected flooring materials, equipment and contents. Remove areas that could be affected by mold. Potentially considerable downtime. Cleanup and replacement of all water damaged items on floor. User must establish area of floor with flooding. Default recommendation is flooding of total floor area. Damage to unit floor area shall be entered to consequence which is multiplied by PACT "Fragility Unit of Measure".				

Long Lead Time (Yes / No)NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.45E+01	3.86E+01	4.95E+01												
Best fit mean:	3.75E+01														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00		2000.00												
Average Repair Cost (Min Qty, Max Qty)	7.72E+01		2.32E+01												
CV or beta (Min Qty, Max Qty)	0.26		0.26												
Quantity Unit:	Each (1'x1')														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.27E-02	3.58E-02	4.59E-02												
Best fit mean:	3.58E-02														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00		2000.00												
Average Repair Time (Min Qty, Max Qty)	7.16E-02		2.15E-02												
CV or beta (Min Qty, Max Qty)	0.36		0.36												
Quantity Unit:	Each (1'x1')														
LifeSafety Hazard:	NO														
Potential non-collapse casualties? (Yes / No)	Not Applicable														
Casualty-affected Planar Area (sf) per Normative Unit:															
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	2015-07-28 Made consequence generic for user specification according to particulars of structure.														

Root Cost Multiplier:1

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

C3021.001h

Generic Floor Covering - Flooding of floor caused by failure of pipe - School - Humid
The user needs to review the fragilities of all piping modeled in the ceiling of the floor and input the peak floor acceleration value for the pipe with the lowest median peak floor acceleration value, along with the associated total dispersion (beta). Flooding type assumed to be vinyl composition tile. Available costs are per one square foot of floor area.

Line 390

Construction Quality:	Normal
Seismic Installation Conditions:	Not Specified
Fragility Unit of Measure:	By User
Demand Parameter (unit):	Peak Floor Acceleration g
Number of Damage States:	1
Damage State:	DS1
Type of Damage State:	Sequential
DS Hierarchy	Seq(DS1)
Descriptions	Flooding of all or a portion of the total floor associated with a major leakage of a pipe.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none				
1.00				

Damage State Probability:	1.00
Fragility Parameters	
Median Demand, θ :	By User
Data dispersion, β_d :	Not Specified
Uncertainty, β_u :	Not Specified
Total Dispersion, β :	By User
Correlation (Yes / No)	NO
Directionality (Yes / No)	NO
Quality Ratings	
Data Quality	Not Rated
Data Relevance	Not Rated
Documentation Quality	Not Rated
Rationality	Not Rated
Consequence Functions	
Repair Description	Replace or dry out of the affected flooring materials, equipment and contents. Remove areas that could be affected by mold. Potentially considerable downtime. Cleanup and replacement of all water damaged items on floor. User must establish area of floor with flooding. Default recommendation is flooding of total floor area. Damage to unit floor area shall be entered to consequence which is multiplied by PACT "Fragility Unit of Measure".

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.06E+01	4.62E+01	6.21E+01												
Best fit mean:	4.63E+01														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00		2000.00												
Average Repair Cost (Min Qty, Max Qty)	9.24E+01		2.77E+01												
CV or beta (Min Qty, Max Qty)	0.27		0.27												
Quantity Unit:	Each (1'x1')														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.83E-02	4.28E-02	5.75E-02												
Best fit mean:	4.28E-02														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00		2000.00												
Average Repair Time (Min Qty, Max Qty)	8.56E-02		2.57E-02												
CV or beta (Min Qty, Max Qty)	0.36		0.36												
Quantity Unit:	Each (1'x1')														
LifeSafety Hazard:	NO														
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	2015-07-28 Made consequence generic for user specification according to particulars of structure.														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

C3021.001i

Generic Floor Covering - Flooding of floor caused by failure of pipe - Apartments - Dry

The user needs to review the fragilities of all piping modeled in the ceiling of the floor and input the peak floor acceleration value for the pipe with the lowest median peak floor acceleration value, along with the associated total dispersion (beta). Flooding type assumed to be carpet. Available costs are per one square foot of floor area.

Line 391

Construction Quality:	Normal				
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	By User				
Demand Parameter (unit):	Peak Floor Acceleration	g			
Number of Damage States:	1				
Damage State:	DS1				
Type of Damage State:	Sequential				
DS Hierarchy	Seq(DS1)				
Descriptions	Flooding of all or a portion of the total floor associated with a major leakage of a pipe.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations

none				
1.00				

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	By User				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	By User				
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Replace or dry out of the affected flooring materials, equipment and contents. Remove areas that could be affected by mold. Potentially considerable downtime. Cleanup and replacement of all water damaged items on floor. User must establish area of floor with flooding. Default recommendation is flooding of total floor area. Damage to unit floor area shall be entered to consequence which is multiplied by PACT "Fragility Unit of Measure".				

Long Lead Time (Yes / No)

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.64E+01	2.65E+01	3.46E+01												
Best fit mean:	2.58E+01														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00		2000.00												
Average Repair Cost (Min Qty, Max Qty)	5.30E+01		1.59E+01												
CV or beta (Min Qty, Max Qty)	0.27		0.27												
Quantity Unit:	Each (1'x1')														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.52E-02	2.46E-02	3.21E-02												
Best fit mean:	2.46E-02														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00		2000.00												
Average Repair Time (Min Qty, Max Qty)	4.92E-02		1.48E-02												
CV or beta (Min Qty, Max Qty)	0.37		0.37												
Quantity Unit:	Each (1'x1')														
LifeSafety Hazard:	NO														
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	2015-07-28 Made consequence generic for user specification according to particulars of structure.														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

C3021.001k

Generic Floor Covering - Flooding of floor caused by failure of pipe - Retail - Dry
The user needs to review the fragilities of all piping modeled in the ceiling of the floor and input the peak floor acceleration value for the pipe with the lowest median peak floor acceleration value, along with the associated total dispersion (beta). Flooding type assumed to be vinyl composition tile. Available costs are per one square foot of floor area.

Line 393

Construction Quality:	Normal
Seismic Installation Conditions:	Not Specified
Fragility Unit of Measure:	By User
Demand Parameter (unit):	Peak Floor Acceleration g
Number of Damage States:	1
Damage State:	DS1
Type of Damage State:	Sequential
DS Hierarchy	Seq(DS1)
Descriptions	Flooding of all or a portion of the total floor associated with a major leakage of a pipe.

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations

none				
1.00				

Damage State Probability:	1.00
Fragility Parameters	
Median Demand, θ :	By User
Data dispersion, β_d :	Not Specified
Uncertainty, β_u :	Not Specified
Total Dispersion, β :	By User
Correlation (Yes / No)	NO
Directionality (Yes / No)	NO
Quality Ratings	
Data Quality	Not Rated
Data Relevance	Not Rated
Documentation Quality	Not Rated
Rationality	Not Rated
Consequence Functions	
Repair Description	Replace or dry out of the affected flooring materials, equipment and contents. Remove areas that could be affected by mold. Potentially considerable downtime. Cleanup and replacement of all water damaged items on floor. User must establish area of floor with flooding. Default recommendation is flooding of total floor area. Damage to unit floor area shall be entered to consequence which is multiplied by PACT "Fragility Unit of Measure".

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.39E+01	2.94E+01	3.79E+01												
Best fit mean:	2.71E+01														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00		2000.00												
Average Repair Cost (Min Qty, Max Qty)	5.88E+01		1.76E+01												
CV or beta (Min Qty, Max Qty)	0.35		0.35												
Quantity Unit:	Each (1'x1')														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.29E-02	2.72E-02	3.51E-02												
Best fit mean:	2.72E-02														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00		2000.00												
Average Repair Time (Min Qty, Max Qty)	5.44E-02		1.63E-02												
CV or beta (Min Qty, Max Qty)	0.43		0.43												
Quantity Unit:	Each (1'x1')														
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	2015-07-28 Made consequence generic for user specification according to particulars of structure.														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

C3021.001I

Generic Floor Covering - Flooding of floor caused by failure of pipe - Retail - Humid
The user needs to review the fragilities of all piping modeled in the ceiling of the floor and input the peak floor acceleration value for the pipe with the lowest median peak floor acceleration value, along with the associated total dispersion (beta). Flooring type assumed to be vinyl composition tile. Available costs are per one square foot of floor area.

Line 394

Construction Quality:	Normal	<div>Quantity RoundingRound Qty? NO Allow sum by floor or building? NO Demand Location (floor above?) Yes</div>
Seismic Installation Conditions:	Not Specified	
Fragility Unit of Measure:	By User	
Demand Parameter (unit):	Peak Floor Accelerationg	
Number of Damage States:	1	
Damage State:	DS1	
Type of Damage State:	Sequential	
DS Hierarchy	Seq(DS1)	
Descriptions	Flooding of all or a portion of the total floor associated with a major leakage of a pipe.	

Illustrations					
	none				
Damage State Probability:	1.00				

Fragility Parameters					
Median Demand, θ :	By User				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	By User				
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Replace or dry out of the affected flooring materials, equipment and contents. Remove areas that could be affected by mold. Potentially considerable downtime. Cleanup and replacement of all water damaged items on floor. User must establish area of floor with flooding. Default recommendation is flooding of total floor area. Damage to unit floor area shall be entered to consequence which is multiplied by PACT "Fragility Unit of Measure".				

Long Lead Time (Yes / No)NO

Repair Costs:	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀
Repair Cost by Damage State:	2.99E+014.94E+016.60E+01				
Best fit mean:	4.84E+01				
Best Fit Distribution:	Normal				
Quantity Plateau (Min Qty, Max Qty)	500.002000.00				
Average Repair Cost (Min Qty, Max Qty)	9.88E+012.96E+01				
CV or beta (Min Qty, Max Qty)	0.290.29				
Quantity Unit:	Each (1'x1')				
Repair Time:	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀
Repair Time by Damage State:	2.77E-024.58E-026.11E-02				
Best fit mean:	4.58E-02				
Best Fit Distribution:	Normal				
Quantity Plateau (Min Qty, Max Qty)	500.002000.00				
Average Repair Time (Min Qty, Max Qty)	9.16E-022.75E-02				
CV or beta (Min Qty, Max Qty)	0.380.38				
Quantity Unit:	Each (1'x1')				
LifeSafety Hazard:					
Potential non-collapse casualties? (Yes / No)	NO				
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable				
Serious Injury (Median, Dispersion)	0%0.00				
Loss of Life (Median, Dispersion)	0%0.00				
Post-event Tagging Flag:	NO				
Unsafe Placard Trigger (Median, Dispersion)	0%0.00				
Comments:	None				
Date Created:	Not Given				
Approved (YES / NO)?	By User				
Official (YES / NO) ?	By User				
Author:	Not Given				
Revisions:	2015-07-28 Made consequence generic for user specification according to particulars of structure.				

Root Cost Multiplier:1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

C3021.001m

Generic Floor Covering - Flooding of floor caused by failure of pipe - Warehouse - Dry
The user needs to review the fragilities of all piping modeled in the ceiling of the floor and input the peak floor acceleration value for the pipe with the lowest median peak floor acceleration value, along with the associated total dispersion (beta). Flooding type assumed to be sealed concrete. Available costs are per one square foot of floor area.

Line 395

Construction Quality: Normal

Seismic Installation Conditions: Not Specified

Fragility Unit of Measure: By User

Demand Parameter (unit): Peak Floor Acceleration g

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1)

Descriptions: Flooding of all or a portion of the total floor associated with a major leakage of a pipe.

Quantity Rounding

Round Qty? NO

Allow sum by floor or building? NO

Demand Location (floor above?) Yes

Illustrations

none				
1.00				

Damage State Probability: 1.00

Fragility Parameters

Median Demand, θ : By User

Data dispersion, β_d : Not Specified

Uncertainty, β_u : Not Specified

Total Dispersion, β : By User

Correlation (Yes / No): NO

Directionality (Yes / No): NO

Quality Ratings

Data Quality: Not Rated

Data Relevance: Not Rated

Documentation Quality: Not Rated

Rationality: Not Rated

Consequence Functions

Repair Description: Replace or dry out of the affected flooring materials, equipment and contents. Remove areas that could be affected by mold. Potentially considerable downtime. Cleanup and replacement of all water damaged items on floor. User must establish area of floor with flooding. Default recommendation is flooding of total floor area. Damage to unit floor area shall be entered to consequence which is multiplied by PACT "Fragility Unit of Measure".

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State: 4.04E+00 1.01E+01 1.35E+01

Best fit mean: 9.19E+00

Best Fit Distribution: Normal

Quantity Plateau (Min Qty, Max Qty): 500.00 2000.00

Average Repair Cost (Min Qty, Max Qty): 2.01E+01 6.03E+00

CV or beta (Min Qty, Max Qty): 0.40 0.40

Quantity Unit: Each (1'x1')

Repair Time:

Repair Time by Damage State: 3.70E-03 9.30E-03 1.25E-02

Best fit mean: 9.30E-03

Best Fit Distribution: Normal

Quantity Plateau (Min Qty, Max Qty): 500.00 2000.00

Average Repair Time (Min Qty, Max Qty): 1.86E-02 5.58E-03

CV or beta (Min Qty, Max Qty): 0.47 0.47

Quantity Unit: Each (1'x1')

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No): NO

Casualty-affected Planar Area (sf) per Normative Unit: Not Applicable

Serious Injury (Median, Dispersion): 0% 0.00

Loss of Life (Median, Dispersion): 0% 0.00

Post-event Tagging Flag: NO

Unsafe Placard Trigger (Median, Dispersion): 0% 0.00

Comments: None

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: 2015-07-28 Made consequence generic for user specification according to particulars of structure.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

C3021.001n

Generic Floor Covering - Flooding of floor caused by failure of pipe - Warehouse - Humid

The user needs to review the fragilities of all piping modeled in the ceiling of the floor and input the peak floor acceleration value for the pipe with the lowest median peak floor acceleration value, along with the associated total dispersion (beta). Flooding type assumed to be sealed concrete. Available costs are per one square foot of floor area.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

Not Specified

By User

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Flooding of all or a portion of the total floor associated with a major leakage of a pipe.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO

Yes

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User

Not Specified

Not Specified

By User

NO

NO

Not Rated

Not Rated

Not Rated

Not Rated

Replace or dry out of the affected flooring materials, equipment and contents. Remove areas that could be affected by mold. Potentially considerable downtime. Cleanup and replacement of all water damaged items on floor. User must establish area of floor with flooding. Default recommendation is flooding of total floor area. Damage to unit floor area shall be entered to consequence which is multiplied by PACT "Fragility Unit of Measure".

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

1.28E+01

2.40E+01

3.26E+01

P₁₀

P₅₀

P₉₀

2.31E+01

Normal

500.00

2000.00

P₁₀

P₅₀

P₉₀

4.80E+01

1.44E+01

0.33

0.33

Each (1'x1')

P₁₀

P₅₀

P₉₀

1.19E-02

2.22E-02

3.02E-02

P₁₀

P₅₀

P₉₀

2.22E-02

Normal

500.00

2000.00

P₁₀

P₅₀

P₉₀

4.44E-02

1.33E-02

0.42

0.42

Each (1'x1')

P₁₀

P₅₀

P₉₀

NO

Not Applicable

0%

0.00

P₁₀

P₅₀

P₉₀

NO

0%

0.00

None

Not Given

By User

By User

Not Given

2015-07-28 Made consequence generic for user specification according to particulars of structure.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

C3021.001o

Generic Floor Covering - Flooding of floor caused by failure of pipe - Hospitality - Dry

The user needs to review the fragilities of all piping modeled in the ceiling of the floor and input the peak floor acceleration value for the pipe with the lowest median peak floor acceleration value, along with the associated total dispersion (beta). Flooding type assumed to be carpet. Available costs are per one square foot of floor area.

Line 397

Construction Quality:	Normal
Seismic Installation Conditions:	Not Specified
Fragility Unit of Measure:	By User
Demand Parameter (unit):	Peak Floor Acceleration g
Number of Damage States:	1
Damage State:	DS1
Type of Damage State:	Sequential
DS Hierarchy	Seq(DS1)
Descriptions	Flooding of all or a portion of the total floor associated with a major leakage of a pipe.

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations

none				
1.00				

Damage State Probability:	1.00
Fragility Parameters	
Median Demand, θ :	By User
Data dispersion, β_d :	Not Specified
Uncertainty, β_u :	Not Specified
Total Dispersion, β :	By User
Correlation (Yes / No)	NO
Directionality (Yes / No)	NO
Quality Ratings	
Data Quality	Not Rated
Data Relevance	Not Rated
Documentation Quality	Not Rated
Rationality	Not Rated
Consequence Functions	
Repair Description	Replace or dry out of the affected flooring materials, equipment and contents. Remove areas that could be affected by mold. Potentially considerable downtime. Cleanup and replacement of all water damaged items on floor. User must establish area of floor with flooding. Default recommendation is flooding of total floor area. Damage to unit floor area shall be entered to consequence which is multiplied by PACT "Fragility Unit of Measure".

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.43E+01	2.79E+01	3.57E+01												
Best fit mean:	2.60E+01														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00		2000.00												
Average Repair Cost (Min Qty, Max Qty)	5.58E+01		1.67E+01												
CV or beta (Min Qty, Max Qty)	0.32		0.32												
Quantity Unit:	Each (1'x1')														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.39E-02	2.71E-02	3.47E-02												
Best fit mean:	2.71E-02														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00		2000.00												
Average Repair Time (Min Qty, Max Qty)	5.42E-02		1.63E-02												
CV or beta (Min Qty, Max Qty)	0.41		0.41												
Quantity Unit:	Each (1'x1')														
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	2015-07-28 Made consequence generic for user specification according to particulars of structure.														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

C3021.001p

Generic Floor Covering - Flooding of floor caused by failure of pipe - Hospitality - Humid

The user needs to review the fragilities of all piping modeled in the ceiling of the floor and input the peak floor acceleration value for the pipe with the lowest median peak floor acceleration value, along with the associated total dispersion (beta). Flooring type assumed to be carpet. Available costs are per one square foot of floor area.

Line 398

Construction Quality:	Normal				
Seismic Installation Conditions:	Not Specified				
Fragility Unit of Measure:	By User				
Demand Parameter (unit):	Peak Floor Acceleration	g			
Number of Damage States:	1				
Damage State:	DS1				
Type of Damage State:	Sequential				
DS Hierarchy	Seq(DS1)				
Descriptions	Flooding of all or a portion of the total floor associated with a major leakage of a pipe.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations

none				
1.00				

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	By User				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	By User				
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Replace or dry out of the affected flooring materials, equipment and contents. Remove areas that could be affected by mold. Potentially considerable downtime. Cleanup and replacement of all water damaged items on floor. User must establish area of floor with flooding. Default recommendation is flooding of total floor area. Damage to unit floor area shall be entered to consequence which is multiplied by PACT "Fragility Unit of Measure".				

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	4.82E+01	7.02E+01	9.52E+01												
Best fit mean:	7.12E+01														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00		2000.00												
Average Repair Cost (Min Qty, Max Qty)	8.42E+01		5.62E+01												
CV or beta (Min Qty, Max Qty)	0.26		0.26												
Quantity Unit:	Each (1'x1')														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	4.67E-02	6.81E-02	9.24E-02												
Best fit mean:	6.81E-02														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	500.00		2000.00												
Average Repair Time (Min Qty, Max Qty)	8.17E-02		5.45E-02												
CV or beta (Min Qty, Max Qty)	0.36		0.36												
Quantity Unit:	Each (1'x1')														
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	2015-07-28 Made consequence generic for user specification according to particulars of structure.														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification C3027.001

NISTIR Name Raised Access Floor, non seismically rated.

Description Access floor unanchored or anchored with adhesive. Costing is based upon a xxx SF floor area.

Line 399

Construction Quality:	Normal				
Seismic Installation Conditions:	All				
Fragility Unit of Measure:	SF 100				
Demand Parameter (unit):	Peak Floor Acceleration	g			
Number of Damage States:	1				
Damage State:	DS1				
Type of Damage State:	Sequential				
DS Hierarchy	Seq(DS1)				
Descriptions	Minor damage to the flooring system. Damage to the equipment of the flooring system.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none				
Damage State Probability:	1.00				

Fragility Parameters					
Median Demand, θ :	0.5				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	0.5				
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Repair the flooring system, assume cost equal to 5% of the replacement cost. Repair the flooring equipment, assume a cost equal to 10% of the replacement cost.				

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	4.00E+01	1.15E+02	6.30E+02												
Best fit mean:	1.21E+02														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00												
Average Repair Cost (Min Qty, Max Qty)	1.38E+02		9.20E+01												
CV or beta (Min Qty, Max Qty)	1.28		1.28												
Quantity Unit:	100 ft^2 Units														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	4.00E-02	1.10E-01	6.10E-01												
Best fit mean:	1.10E-01														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	5.00		20.00												
Average Repair Time (Min Qty, Max Qty)	1.32E-01		8.77E-02												
CV or beta (Min Qty, Max Qty)	1.31		1.31												
Quantity Unit:	100 ft^2 Units														
LifeSafety Hazard:	NO														
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	Consequence Note: Some downtime for repair of floor and equipment.														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														

Root Cost Multiplier: 100

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

C3027.002

Raised Access Floor, seismically rated.

Access floor is designed to meet code requirements and mechanically anchored and braced as necessary to resist anchor loads. Equipment is anchored to floor systems and heavier equipment is anchored directly to the structural floor. Costing is based upon a xxx SF floor area.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

All

SF 100

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Minor damage to the flooring system.

Damage to the equipment of the flooring system.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO

No

Illustrations

none

1.00

1.5

Not Specified

Not Specified

0.4

NO

NO

Not Rated

Not Rated

Not Rated

Not Rated

Repair the flooring system, assume cost equal to 5% of the replacement cost.

Repair the flooring equipment, assume a cost equal to 10% of the replacement cost.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

4.00E+01

1.15E+02

6.30E+02

1.21E+02

LogNormal

5.00

20.00

1.38E+02

9.20E+01

1.28

1.28

100 ft^2 Units

4.00E-02

1.20E-01

6.80E-01

1.20E-01

LogNormal

5.00

20.00

1.45E-01

9.53E-02

1.31

1.31

100 ft^2 Units

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Consequence Note: Some downtime for repair of floor and equipment.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

100

FEMA P-58 Fragility Specification

NISTIR Classification C3032.001a
NISTIR Name Suspended Ceiling, SDC A,B,C, Area (A): A < 250, Vert support only
Description Costing for each 250 SF Unit, Suspended Lay-in Acoustic Tile Ceiling, Support: Vertical hanging wires only. Includes lighting fixtures in suspended ceiling.

Line 401

Construction Quality:	Normal			
Seismic Installation Conditions:	SDC A, B, or C			
Fragility Unit of Measure:	SF 250			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	5 % of ceiling grid and tile damage.	30% of ceiling grid and tile damage.	50% of ceiling grid and tile damage.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	1.17	1.58	1.82		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	0.25	0.25	0.25		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Superior				
Documentation Quality	Marginal				
Rationality	Average				
Consequence Functions					
Repair Description	Reinstall, repair, or replace 5% of the ceiling area.	Replace 30% of the ceiling area.	Replace the entire ceiling		

Long Lead Time (Yes / No)	NO			NO			NO								
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.00E+02	3.63E+02	6.00E+02	1.35E+03	2.84E+03	5.35E+03	4.69E+03	5.84E+03	7.79E+03						
Best fit mean:	3.54E+02			2.76E+03			5.97E+03								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00	10.00		1.00	10.00		1.00	10.00							
Average Repair Cost (Min Qty, Max Qty)	4.35E+02	2.90E+02		3.41E+03	2.27E+03		7.01E+03	4.67E+03							
CV or beta (Min Qty, Max Qty)	0.55	0.55		0.52	0.52		0.20	0.20							
Quantity Unit:	250 ft^2 Units			250 ft^2 Units			250 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.00E-01	3.50E-01	5.75E-01	1.30E+00	2.70E+00	5.13E+00	4.48E+00	5.58E+00	7.45E+00						
Best fit mean:	3.50E-01			2.70E+00			5.58E+00								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00	10.00		1.00	10.00		1.00	10.00							
Average Repair Time (Min Qty, Max Qty)	4.19E-01	2.81E-01		3.24E+00	2.16E+00		6.69E+00	4.46E+00							
CV or beta (Min Qty, Max Qty)	0.60	0.60		0.58	0.58		0.32	0.32							
Quantity Unit:	250 ft^2 Units			250 ft^2 Units			250 ft^2 Units								
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			YES								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			250 SF								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		10%	0.50							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			NO								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	2015-07-28 Update median demand and dispersion beta. 2015-08-21 Added SDC C														
	Root Cost Multiplier: 250														

Root Cost Multiplier: 250

FEMA P-58 Fragility Specification

NISTIR Classification C3032.001b
NISTIR Name Suspended Ceiling, SDC A,B,C, Area (A): 250 < A < 1000, Vert support only
Description Costing for each 600 SF Unit, Suspended Lay-in Acoustic Tile Ceiling, Support: Vertical hanging wires only. Includes lighting fixtures in suspended ceiling.

Line 402

Construction Quality:	Normal			
Seismic Installation Conditions:	SDC A, B, or C			
Fragility Unit of Measure:	SF 600			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	5 % of ceiling grid and tile damage.	30% of ceiling grid and tile damage.	50% of ceiling grid and tile damage.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	1.01	1.45	1.69		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	0.25	0.25	0.25		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Superior				
Documentation Quality	Marginal				
Rationality	Average				
Consequence Functions					
Repair Description	Reinstall, repair, or replace 5% of the ceiling area.	Replace 30% of the ceiling area.	Replace the entire ceiling		

Long Lead Time (Yes / No)	NO			NO			NO								
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.40E+02	8.70E+02	1.44E+03	3.24E+03	6.81E+03	1.28E+04	1.13E+04	1.40E+04	1.87E+04						
Best fit mean:	8.50E+02			6.83E+03			1.43E+04								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00	10.00		1.00	10.00		1.00	10.00							
Average Repair Cost (Min Qty, Max Qty)	1.04E+03	6.96E+02		8.17E+03	5.45E+03		1.68E+04	1.12E+04							
CV or beta (Min Qty, Max Qty)	0.55	0.55		0.52	0.52		0.20	0.20							
Quantity Unit:	600 ft^2 Units			600 ft^2 Units			600 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.40E+01	7.80E+01	1.32E+00	2.94E+00	6.18E+00	1.17E+01	1.03E+01	1.28E+01	1.70E+01						
Best fit mean:	7.80E+01			6.18E+00			1.28E+01								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00	10.00		1.00	10.00		1.00	10.00							
Average Repair Time (Min Qty, Max Qty)	9.39E-01	6.21E-01		7.42E+00	4.94E+00		1.53E+01	1.02E+01							
CV or beta (Min Qty, Max Qty)	0.60	0.60		0.58	0.58		0.32	0.32							
Quantity Unit:	600 ft^2 Units			600 ft^2 Units			600 ft^2 Units								
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			YES								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			650 SF								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		10%	0.50							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			NO								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	2015-07-28 Update median demand and dispersion beta. 2015-08-21 Added SDC C														

Root Cost Multiplier: 600

FEMA P-58 Fragility Specification

NISTIR Classification C3032.001c
NISTIR Name Suspended Ceiling, SDC A,B,C, Area (A): 1000 < A < 2500, Vert support only
Description Costing for each 1800 SF Unit, Suspended Lay-in Acoustic Tile Ceiling, Support: Vertical hanging wires only. Includes lighting fixtures in suspended ceiling.

Line 403

Construction Quality:	Normal			
Seismic Installation Conditions:	SDC A, B, or C			
Fragility Unit of Measure:	SF 1800			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	5 % of ceiling grid and tile damage.	30% of ceiling grid and tile damage.	50% of ceiling grid and tile damage.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	Yes	

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.7	1.2	1.43		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	0.25	0.25	0.25		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Superior				
Documentation Quality	Marginal				
Rationality	Average				
Consequence Functions					
Repair Description	Reinstall, repair, or replace 5% of the ceiling area.	Replace 30% of the ceiling area.	Replace the entire ceiling		

Long Lead Time (Yes / No)	NO			NO			NO								
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	7.20E+02	2.61E+03	4.32E+03	9.72E+03	2.04E+04	3.85E+04	3.38E+04	4.20E+04	5.61E+04						
Best fit mean:	2.55E+03			1.99E+04			4.30E+04								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00	10.00		1.00	10.00		1.00	10.00							
Average Repair Cost (Min Qty, Max Qty)	3.13E+03	2.09E+03		2.45E+04	1.63E+04		5.04E+04	3.36E+04							
CV or beta (Min Qty, Max Qty)	0.55	0.55		0.52	0.52		0.20	0.20							
Quantity Unit:	1800 ft^2 Units			1800 ft^2 Units			1800 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	7.20E+01	2.34E+00	3.78E+00	8.64E+00	1.80E+01	3.40E+01	2.97E+01	3.71E+01	4.95E+01						
Best fit mean:	2.34E+00			1.80E+01			3.71E+01								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00	10.00		1.00	10.00		1.00	10.00							
Average Repair Time (Min Qty, Max Qty)	2.80E+00	1.88E+00		2.16E+01	1.44E+01		4.45E+01	2.97E+01							
CV or beta (Min Qty, Max Qty)	0.60	0.60		0.58	0.58		0.32	0.32							
Quantity Unit:	1800 ft^2 Units			1800 ft^2 Units			1800 ft^2 Units								
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			YES								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			1700 SF								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		10%	0.50							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			NO								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	2015-07-28 Update median demand and dispersion beta. 2015-08-21 Added SDC C														
	Root Cost Multiplier: 1800														

Root Cost Multiplier: 1800

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

C3032.001d
Suspended Ceiling, SDC A,B,C, Area (A): A > 2500, Vert support only
Costing for each 2500 SF Unit, Suspended Lay-in Acoustic Tile Ceiling, Support: Vertical hanging wires only. Includes lighting fixtures in suspended ceiling.

Line 404

Construction Quality:	Normal			
Seismic Installation Conditions:	SDC A, B, or C			
Fragility Unit of Measure:	SF 2500			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	5 % of ceiling grid and tile damage.	30% of ceiling grid and tile damage.	50% of ceiling grid and tile damage.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations					
	none	none	none		
Damage State Probability:	1.00	1.00	1.00		
Fragility Parameters					
Median Demand, θ :	0.56	1.08	1.31		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	0.25	0.25	0.25		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Superior				
Documentation Quality	Marginal				
Rationality	Average				
Consequence Functions					
Repair Description	Reinstall, repair, or replace 5% of the ceiling area.	Replace 30% of the ceiling area.	Replace the entire ceiling		

Long Lead Time (Yes / No)	NO	NO	NO		
Repair Costs:					
Repair Cost by Damage State:	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀
Best fit mean:	1.00E+03 3.63E+03 6.00E+03	1.35E+04 2.84E+04 5.35E+04	4.69E+04 5.84E+04 7.79E+04		
Best Fit Distribution:	3.54E+03 Normal	2.76E+04 LogNormal	5.97E+04 LogNormal		
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00	1.00 10.00	1.00 10.00		
Average Repair Cost (Min Qty, Max Qty)	4.35E+03 2.90E+03	3.41E+04 2.27E+04	7.01E+04 4.67E+04		
CV or beta (Min Qty, Max Qty)	0.55 0.55	0.52 0.52	0.20 0.20		
Quantity Unit:	2500 ft^2 Units	2500 ft^2 Units	2500 ft^2 Units		
Repair Time:					
Repair Time by Damage State:	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀
Best fit mean:	7.50E-01 3.00E+00 5.00E+00	1.15E+01 2.43E+01 4.58E+01	4.00E+01 4.98E+01 6.65E+01		
Best Fit Distribution:	3.00E+00 Normal	2.43E+01 LogNormal	4.98E+01 LogNormal		
Quantity Plateau (Min Qty, Max Qty)	1.00 10.00	1.00 10.00	1.00 10.00		
Average Repair Time (Min Qty, Max Qty)	3.62E+00 2.38E+00	2.91E+01 1.94E+01	5.97E+01 3.98E+01		
CV or beta (Min Qty, Max Qty)	0.60 0.60	0.58 0.58	0.32 0.32		
Quantity Unit:	2500 ft^2 Units	2500 ft^2 Units	2500 ft^2 Units		
LifeSafety Hazard:					
Potential non-collapse casualties? (Yes / No)	NO	NO	YES		
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable	Not Applicable	2500 SF		
Serious Injury (Median, Dispersion)	0% 0.00	0% 0.00	10% 0.50		
Loss of Life (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00		
Post-event Tagging Flag:	NO	YES	YES		
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00	75% 0.50	50% 0.50		
Comments:	None				
Date Created:	Not Given				
Approved (YES / NO)?	By User				
Official (YES / NO) ?	By User				
Author:	Not Given				
Revisions:	2015-07-28 Update median demand and dispersion beta. 2015-08-21 Added SDC C				

Root Cost Multiplier: 2500

Revisions: 2015-07-28 Update median demand and dispersion beta.

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

C3032.003b

Suspended Ceiling, SDC D,E (Ip=1.0), Area (A): 250 < A < 1000, Vert & Lat support
Costing for each 600 SF Unit, Suspended Lay-in Acoustic Tile Ceiling, Support: Vertical hanging wire, diagonal wires, and compression posts, 2 inch wide ledger support angles at wall and oversize holes around tile openings. Includes lighting fixtures in suspended ceiling.

Line 406

Construction Quality:	Normal			
Seismic Installation Conditions:	SDC D or E (Ip = 1.0)			
Fragility Unit of Measure:	SF 600			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Sequential	Sequential	Sequential	
DS Hierarchy	Seq(DS1,DS2,DS3)			
Descriptions	5 % of ceiling grid and tile damage.	30% of ceiling grid and tile damage.	50% of ceiling grid and tile damage.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	1.47	1.88	2.03	
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified	
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified	
Total Dispersion, β :	0.3	0.3	0.3	
Correlation (Yes / No)	NO			
Directionality (Yes / No)	NO			
Quality Ratings				
Data Quality	Marginal			
Data Relevance	Superior			
Documentation Quality	Marginal			
Rationality	Average			
Consequence Functions				
Repair Description	Reinstall, repair, or replace 5% of the ceiling area.	Replace 30% of the ceiling area.	Replace the entire ceiling	

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.40E+02	8.70E+02	1.44E+03	3.24E+03	6.81E+03	1.28E+04	1.13E+04	1.40E+04	1.87E+04						
Best fit mean:	8.50E+02			6.83E+03			1.43E+04								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00	10.00		1.00	10.00		1.00	10.00							
Average Repair Cost (Min Qty, Max Qty)	1.74E+03	5.22E+02		1.36E+04	4.09E+03		2.80E+04	8.41E+03							
CV or beta (Min Qty, Max Qty)	0.55	0.55		0.52	0.52		0.20	0.20							
Quantity Unit:	600 ft² Units			600 ft² Units			600 ft² Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.40E-01	7.80E-01	1.32E+00	2.94E+00	6.18E+00	1.17E+01	1.03E+01	1.28E+01	1.70E+01						
Best fit mean:	7.80E-01			6.18E+00			1.28E+01								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00	10.00		1.00	10.00		1.00	10.00							
Average Repair Time (Min Qty, Max Qty)	1.57E+00	4.63E-01		1.24E+01	3.70E+00		2.56E+01	7.67E+00							
CV or beta (Min Qty, Max Qty)	0.60	0.60		0.58	0.58		0.32	0.32							
Quantity Unit:	600 ft² Units			600 ft² Units			600 ft² Units								
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			YES								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			650 SF								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		10%	0.50							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			NO								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							

Root Cost Multiplier: 600

FEMA P-58 Fragility Specification

NISTIR Classification

C3032.003c

Line 407

NISTIR Name
Description

Suspended Ceiling, SDC D,E (Ip=1.0), Area (A): 1000 < A < 2500, Vert & Lat support
Costing for each 1800 SF Unit, Suspended Lay-in Acoustic Tile Ceiling, Support: Vertical hanging wire, diagonal wires, and compression posts, 2 inch wide ledger support angles at wall and oversize holes around tile openings. Includes lighting fixtures in suspended ceiling.

Construction Quality:	Normal				
Seismic Installation Conditions:	SDC D or E (Ip = 1.0)				
Fragility Unit of Measure:	SF 1800				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	5 % of ceiling grid and tile damage.	30% of ceiling grid and tile damage.	50% of ceiling grid and tile damage.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	Yes	

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	1.21	1.75	1.95		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	0.3	0.3	0.3		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Superior				
Documentation Quality	Marginal				
Rationality	Average				
Consequence Functions					
Repair Description	Reinstall, repair, or replace 5% of the ceiling area.	Replace 30% of the ceiling area.	Replace the entire ceiling		

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	7.20E+02	2.61E+03	4.32E+03	9.72E+03	2.04E+04	3.85E+04	3.38E+04	4.20E+04	5.61E+04						
Best fit mean:	2.55E+03			1.99E+04			4.30E+04								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00		10.00	1.00		10.00	1.00		10.00						
Average Repair Cost (Min Qty, Max Qty)	5.22E+03		1.57E+03	4.09E+04		1.23E+04	8.41E+04		2.52E+04						
CV or beta (Min Qty, Max Qty)	0.55		0.55	0.52		0.52	0.20		0.20						
Quantity Unit:	1800 ft^2 Units			1800 ft^2 Units			1800 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	7.20E+01	2.34E+00	3.78E+00	8.64E+00	1.80E+01	3.40E+01	2.97E+01	3.71E+01	4.95E+01						
Best fit mean:	2.34E+00			1.80E+01			3.71E+01								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00		10.00	1.00		10.00	1.00		10.00						
Average Repair Time (Min Qty, Max Qty)	4.64E+00		1.42E+00	3.60E+01		1.08E+01	7.42E+01		2.22E+01						
CV or beta (Min Qty, Max Qty)	0.60		0.60	0.58		0.58	0.32		0.32						
Quantity Unit:	1800 ft^2 Units			1800 ft^2 Units			1800 ft^2 Units								
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			YES								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			1700 SF								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		10%	0.50							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			NO								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							

Root Cost Multiplier: 1800

FEMA P-58 Fragility Specification

NISTIR Classification

C3032.004c

Line 411

NISTIR Name
Description

Suspended Ceiling, SDC D,E,F (Ip=1.5), Area (A): 1000 < A < 2500, Vert & Lat support
Costing for each 1800 SF Unit, Suspended Lay-in Acoustic Tile Ceiling, Support: Vertical hanging wire, diagonal wires, and compression posts, 2 inch wide ledger support angles at wall and oversize holes around tile openings. Includes lighting fixtures in suspended ceiling.

Construction Quality:

Special Inspection (e.g. OSHPD)

Seismic Installation Conditions:

SDC D, E or F (Ip = 1.5)

Fragility Unit of Measure:

SF 1800

Demand Parameter (unit):

Peak Floor Acceleration g

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Sequential

Sequential

Sequential

DS Hierarchy

Seq(DS1,DS2,DS3)

Descriptions

5 % of ceiling grid and tile damage.

30% of ceiling grid and tile damage.

50% of ceiling grid and tile damage.

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:

Fragility Parameters

Median Demand, θ :

1.45

2.1

2.34

Data dispersion, β_d :

Not Specified

Not Specified

Not Specified

Uncertainty, β_u :

Not Specified

Not Specified

Not Specified

Total Dispersion, β :

0.3

0.3

0.3

Correlation (Yes / No)

NO

Directionality (Yes / No)

NO

Quality Ratings

Data Quality

Marginal

Data Relevance

Superior

Documentation Quality

Marginal

Rationality

Average

Consequence Functions

Repair Description

Reinstall, repair, or replace 5% of the ceiling area.

Replace 30% of the ceiling area.

Replace the entire ceiling

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

7.20E+02

2.61E+03

4.32E+03

9.72E+03

2.04E+04

3.85E+04

3.38E+04

4.20E+04

5.61E+04

Best fit mean:

2.55E+03

1.99E+04

4.30E+04

Best Fit Distribution:

Normal

LogNormal

LogNormal

Quantity Plateau (Min Qty, Max Qty)

1.00

10.00

1.00

10.00

1.00

10.00

Average Repair Cost (Min Qty, Max Qty)

5.22E+03

1.57E+03

4.09E+04

1.23E+04

8.41E+04

2.52E+04

CV or beta (Min Qty, Max Qty)

0.55

0.55

0.52

0.52

0.20

0.20

Quantity Unit:

1800 ft^2 Units

1800 ft^2 Units

1800 ft^2 Units

Repair Time:

Repair Time by Damage State:

7.20E+01

2.34E+00

3.78E+00

8.64E+00

1.80E+01

3.40E+01

2.97E+01

3.71E+01

4.95E+01

Best fit mean:

2.34E+00

1.80E+01

3.71E+01

Best Fit Distribution:

Normal

LogNormal

LogNormal

Quantity Plateau (Min Qty, Max Qty)

1.00

10.00

1.00

10.00

1.00

10.00

Average Repair Time (Min Qty, Max Qty)

4.64E+00

1.42E+00

3.60E+01

1.08E+01

7.42E+01

2.22E+01

CV or beta (Min Qty, Max Qty)

0.60

0.60

0.58

0.58

0.32

0.32

Quantity Unit:

1800 ft^2 Units

1800 ft^2 Units

1800 ft^2 Units

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

NO

NO

YES

Casualty-affected Planar Area (sf) per Normative Unit:

Not Applicable

Not Applicable

1700 SF

Serious Injury (Median, Dispersion)

0%

0.00

0%

0.00

10%

0.50

Loss of Life (Median, Dispersion)

0%

0.00

0%

0.00

0%

0.00

Post-event Tagging Flag:

NO

NO

NO

Unsafe Placard Trigger (Median, Dispersion)

0%

0.00

0%

0.00

0%

0.00

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2015-07-28 Update median demand and dispersion beta.

Root Cost Multiplier: 1800

FEMA P-58 Fragility Specification

NISTIR Classification

C3032.004d

Line 412

NISTIR Name
Description

Suspended Ceiling, SDC D,E,F (Ip=1.5), Area (A): A > 2500, Vert & Lat support
Costing for each 2500 SF Unit, Suspended Lay-in Acoustic Tile Ceiling, Support: Vertical hanging wire, diagonal wires, and compression posts, 2 inch wide ledger support angles at wall and oversize holes around tile openings. Includes lighting fixtures in suspended ceiling.

Construction Quality:	Special Inspection (e.g. OSHPD)				
Seismic Installation Conditions:	SDC D, E or F (Ip = 1.5)				
Fragility Unit of Measure:	SF 2500				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	3				
Damage State:	DS1	DS2	DS3		
Type of Damage State:	Sequential	Sequential	Sequential		
DS Hierarchy	Seq(DS1,DS2,DS3)				
Descriptions	5 % of ceiling grid and tile damage.	30% of ceiling grid and tile damage.	50% of ceiling grid and tile damage.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	Yes	

Illustrations

none	none	none		
1.00	1.00	1.00		

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	1.31	2.03	2.29		
Data dispersion, β_d :	Not Specified	Not Specified	Not Specified		
Uncertainty, β_u :	Not Specified	Not Specified	Not Specified		
Total Dispersion, β :	0.3	0.3	0.3		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Superior				
Documentation Quality	Marginal				
Rationality	Average				
Consequence Functions					
Repair Description	Reinstall, repair, or replace 5% of the ceiling area.	Replace 30% of the ceiling area.	Replace the entire ceiling		

Long Lead Time (Yes / No)

NO NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.00E+03	3.63E+03	6.00E+03	1.35E+04	2.84E+04	5.35E+04	4.69E+04	5.84E+04	7.79E+04						
Best fit mean:	3.54E+03			2.76E+04			5.97E+04								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00	10.00		1.00	10.00		1.00	10.00							
Average Repair Cost (Min Qty, Max Qty)	7.25E+03	2.18E+03		5.68E+04	1.70E+04		1.17E+05	3.50E+04							
CV or beta (Min Qty, Max Qty)	0.55	0.55		0.52	0.52		0.20	0.20							
Quantity Unit:	2500 ft^2 Units			2500 ft^2 Units			2500 ft^2 Units								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	7.50E-01	3.00E+00	5.00E+00	1.15E+01	2.43E+01	4.58E+01	4.00E+01	4.98E+01	6.65E+01						
Best fit mean:	3.00E+00			2.43E+01			4.98E+01								
Best Fit Distribution:	Normal			LogNormal			LogNormal								
Quantity Plateau (Min Qty, Max Qty)	1.00	10.00		1.00	10.00		1.00	10.00							
Average Repair Time (Min Qty, Max Qty)	6.09E+00	1.76E+00		4.85E+01	1.46E+01		9.95E+01	2.98E+01							
CV or beta (Min Qty, Max Qty)	0.60	0.60		0.58	0.58		0.32	0.32							
Quantity Unit:	2500 ft^2 Units			2500 ft^2 Units			2500 ft^2 Units								
LifeSafety Hazard:	NO			NO			YES								
Potential non-collapse casualties? (Yes / No)	NO			NO			YES								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			2500 SF								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		10%	0.50							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			YES			YES								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		75%	0.50		50%	0.50							

Root Cost Multiplier: 2500

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

D1014.011

Line 415

NISTIR Name

Traction Elevator – Applies to most California Installations 1976 or later, most western states installations 1982 or later and most other U.S installations 1998 or later. Costing per elevator. Elevator demand parameter shall be defined as the peak floor acceleration at the first floor. The elevator fragility for a multiple story building should only be entered once on the first floor.

Construction Quality:

Any

Seismic Installation Conditions:

Any

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Peak Floor Acceleration g

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?	BLDG	
Demand Location (floor above?)	No	

Number of Damage States:

4

Damage State:

DS1

DS2

DS3

DS4

Type of Damage State:

Simultaneous

Simultaneous

Simultaneous

Simultaneous

DS Hierarchy

Simul(DS1,DS2,DS3,DS4)

Descriptions




Controller anchorage failed, and or machine anchorage failed, and or governor anchorage failed, and or rope guard failures.

Rail distortion, and or intermediate bracket separate and spread, and or counterweight bracket break or bend, and or car bracket break or bend, and or car guide shoes damaged, and or counterweight guide shoes damaged, and or counterweight frame distortion, and or tail sheave dislodged and/or twisted

Cab stabilizers bent, or cab walls damaged, or cab doors damaged.

Cab ceiling damaged.

Illustrations

		none		
D1014.010-DS1-1.JPG	D1014.010-DS2-6.JPG		D1014.010-DS4-1.JPG	

Damage State Probability:

0.26

0.79

0.68

0.17

Fragility Parameters

Median Demand, θ :

0.39

0.39

0.39

0.39

Data dispersion, β_d :

0.4

Not Specified

Not Specified

Not Specified

Uncertainty, β_u :

0.1

Not Specified

Not Specified

Not Specified

Total Dispersion, β :

0.45

0.45

0.45

0.45

Correlation (Yes / No)

NO

Directionality (Yes / No)

NO

Quality Ratings

Data Quality

Not Rated

Data Relevance

Not Rated

Documentation Quality

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Multiple repairs possible (% change of each): Reinstall or replace controller (4%), and or reinstall or replace motor generator (63%), and or install new generator with appropriate anchors (23%), and or install new governor (7%), and or Reinstall or replace rope guards (15%).

Multiple repairs possible (% change of each): Replace rail (62%), and or replace bracket or tie rod (28%), and or replace counterweight bracket (14%), and or replace intermediate bracket (28%), and or replace car guide shoes (35%), and or replace counterweight guide shoe (28%), and or repair or replace counterweight frame (28%), and or repair or replace tail sheave (1%)

Multiple repairs possible (% change of each): Repair or replace cab walls (3%), and or repair or replace cab doors (17%), and or repair or replace cab stabilizers (92%)

Multiple repairs possible (% change of each): Repair or replace cab ceiling (100%)

Long Lead Time (Yes / No)

YES

YES

YES

YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.50E+03	4.40E+03	1.36E+04	1.14E+04	1.87E+04	2.43E+04	6.00E+03	1.60E+04	2.10E+04	5.00E+02	2.50E+03	3.00E+03			
Best fit mean:	4.43E+03			1.81E+04			1.43E+04			2.00E+03					
Best Fit Distribution:	LogNormal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00	10.00		5.00	10.00		5.00	10.00		5.00	10.00				
Average Repair Cost (Min Qty, Max Qty)	8.80E+03	2.64E+03		3.74E+04	1.12E+04		3.20E+04	9.60E+03		5.00E+03	1.50E+03				
CV or beta (Min Qty, Max Qty)	0.87	0.87		0.28	0.28		0.41	0.41		0.49	0.49				
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.43E+00	4.21E+00	1.30E+01	1.09E+01	1.79E+01	2.32E+01	5.74E+00	1.53E+01	2.01E+01	4.78E-01	2.39E+00	2.87E+00			
Best fit mean:	4.21E+00			1.79E+01			1.53E+01			2.39E+00					
Best Fit Distribution:	LogNormal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00	10.00		5.00	10.00		5.00	10.00		5.00	10.00				
Average Repair Time (Min Qty, Max Qty)	8.41E+00	2.52E+00		3.58E+01	1.07E+01		3.06E+01	9.18E+00		4.78E+00	1.43E+00				
CV or beta (Min Qty, Max Qty)	0.91	0.91		0.37	0.37		0.48	0.48		0.55	0.55				
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			YES					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			40 SF					
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		10%	0.50				
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		5%	0.50				
Post-event Tagging Flag:	NO			NO			NO			NO					
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00				

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

None

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

D1014.012

Line 416

NISTIR Name

Traction Elevator – Applies to most California Installations prior to 1976, most western states installations prior to 1982 and most other U.S installations prior to 1998. Costing per elevator. Elevator demand parameter shall be defined as the peak floor acceleration at the first floor. The elevator fragility for a multiple story building should only be entered once on the first floor.

Construction Quality:

Any

Seismic Installation Conditions:

Any

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Peak Floor Acceleration g

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?	BLDG	
Demand Location (floor above?)	No	

Number of Damage States:

4

Damage State:

DS1

DS2

DS3

DS4

Type of Damage State:

Simultaneous

Simultaneous

Simultaneous

Simultaneous

DS Hierarchy

Simul(DS1,DS2,DS3,DS4)

Descriptions




Controller anchorage failed, and or machine anchorage failed, and or governor anchorage failed, and or rope guard failures.

Rail distortion, and or intermediate bracket separate and spread, and or counterweight bracket break or bend, and or car bracket break or bend, and or car guide shoes damaged, and or counterweight guide shoes damaged, and or counterweight frame distortion, and or tail sheave dislodged and/or twisted

Cab stabilizers bent, or cab walls damaged, or cab doors damaged.

Cab ceiling damaged.

Illustrations

		none		
D1014.010-DS1-1.JPG	D1014.010-DS2-6.JPG		D1014.010-DS4-1.JPG	

Damage State Probability:

0.26

0.79

0.68

0.17

Fragility Parameters

Median Demand, θ :

0.31

0.31

0.31

0.31

Data dispersion, β_d :

Not Specified

Not Specified

Not Specified

Not Specified

Uncertainty, β_u :

Not Specified

Not Specified

Not Specified

Not Specified

Total Dispersion, β :

0.45

0.45

0.45

0.45

Correlation (Yes / No)

NO

Directionality (Yes / No)

NO

Quality Ratings

Data Quality

Not Rated

Data Relevance

Not Rated

Documentation Quality

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Multiple repairs possible (% change of each): Reinstall or replace controller (4%), and or reinstall or replace motor generator (63%), and or install new generator with appropriate anchors (23%), and or install new governor (7%), and or Reinstall or replace rope guards (15%).

Multiple repairs possible (% change of each): Replace rail (62%), and or replace bracket or tie rod (28%), and or replace counterweight bracket (14%), and or replace intermediate bracket (28%), and or replace car guide shoes (35%), and or replace counterweight guide shoe (28%), and or repair or replace counterweight frame (28%), and or repair or replace tail sheave (1%)

Multiple repairs possible (% change of each): Repair or replace cab walls (3%), and or repair or replace cab doors (17%), and or repair or replace cab stabilizers (92%)

Multiple repairs possible (% change of each): Repair or replace cab ceiling (100%)

Long Lead Time (Yes / No)

YES

YES

YES

YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.50E+03	4.40E+03	1.36E+04	1.14E+04	1.87E+04	2.43E+04	6.00E+03	1.60E+04	2.10E+04	5.00E+02	2.50E+03	3.00E+03			
Best fit mean:	4.43E+03			1.81E+04			1.43E+04			2.00E+03					
Best Fit Distribution:	LogNormal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00	5.00		10.00	5.00		10.00	5.00		10.00			
Average Repair Cost (Min Qty, Max Qty)	8.80E+03		2.64E+03	3.74E+04		1.12E+04	3.20E+04		9.60E+03	5.00E+03		1.50E+03			
CV or beta (Min Qty, Max Qty)	0.87		0.87	0.28		0.28	0.41		0.41	0.49		0.49			
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.43E+00	4.21E+00	1.30E+01	1.09E+01	1.79E+01	2.32E+01	5.74E+00	1.53E+01	2.01E+01	4.78E-01	2.39E+00	2.87E+00			
Best fit mean:	4.21E+00			1.79E+01			1.53E+01			2.39E+00					
Best Fit Distribution:	LogNormal			Normal			Normal			Normal					
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00	5.00		10.00	5.00		10.00	5.00		10.00			
Average Repair Time (Min Qty, Max Qty)	8.41E+00		2.52E+00	3.58E+01		1.07E+01	3.06E+01		9.18E+00	4.78E+00		1.43E+00			
CV or beta (Min Qty, Max Qty)	0.91		0.91	0.37		0.37	0.48		0.48	0.55		0.55			
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			YES					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			40 SF					
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		10%	0.50				
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		5%	0.50				
Post-event Tagging Flag:	NO			NO			NO			NO					
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00				

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

None

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D1014.021

Hydraulic Elevator – Applies to most California Installations 1976 or later, most western states installations postdating 1982 and most U.S installations postdating 1998. Costing per elevator. Elevator demand parameter shall be defined as the peak floor acceleration at the first floor. The elevator fragility for a multiple story building should only be entered once on the first floor.

Line 417

Construction Quality:	Any				
Seismic Installation Conditions:	Any				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Peak Floor Acceleration	g			
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Simultaneous	Simultaneous	Simultaneous	Simultaneous	
DS Hierarchy	Simul(DS1,DS2,DS3,DS4)				
Descriptions	Damaged controls.	Damaged vane and hoist-way switches, and or bent cab stabilizers, and or damaged car guide shoes.	Damaged entrance and car door, and or flooring damage.	Oil leak in hydraulic line, and or hydraulic tank failure.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		BLDG
Demand Location (floor above?)		No

Illustrations					
	none	none	none	none	
Damage State Probability:	0.30	0.49	0.44	0.37	
Fragility Parameters					
Median Demand, θ :	0.5	0.5	0.5	0.5	
Data dispersion, β_d :	0.28	Not Specified	Not Specified	Not Specified	
Uncertainty, β_u :	0.1	Not Specified	Not Specified	Not Specified	
Total Dispersion, β :	0.3	0.3	0.3	0.3	
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Multiple repairs possible (% change of each): Repair damaged controls (100%)	Multiple repairs possible (% change of each): Repair damaged vane and hoist-way switches (41%), and or repair bent cab stabilizers (41%), and or repair damaged car guide shoes (41%).	Multiple repairs possible (% change of each): Repair damage to doors (68%), and or repair flooring (46%)	Multiple repairs possible (% change of each): Repair oil leak in hydraulic line (27%), and or hydraulic tank failure (81%)	

Long Lead Time (Yes / No)	NO	NO	YES	NO	
Repair Costs:					
Repair Cost by Damage State:	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀
Best fit mean:	4.00E+02 8.00E+02 2.50E+03	4.20E+03 8.20E+03 1.05E+04	4.00E+03 1.20E+04 1.60E+04	2.00E+03 2.30E+03 3.60E+03	
Best Fit Distribution:	8.68E+02 LogNormal	7.63E+03 Normal	1.07E+04 Normal	2.54E+03 LogNormal	
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00	5.00 10.00	5.00 10.00	5.00 10.00	
Average Repair Cost (Min Qty, Max Qty)	1.60E+03 4.80E+02	1.64E+04 4.92E+03	2.40E+04 7.20E+03	4.60E+03 1.38E+03	
CV or beta (Min Qty, Max Qty)	0.82 0.82	0.32 0.32	0.44 0.44	0.25 0.25	
Quantity Unit:	Each	Each	Each	Each	
Repair Time:					
Repair Time by Damage State:	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀
Best fit mean:	3.82E-01 7.65E-01 2.39E+00	4.01E+00 7.84E+00 1.00E+01	3.82E+00 1.15E+01 1.53E+01	1.91E+00 2.20E+00 3.44E+00	
Best Fit Distribution:	7.65E-01 LogNormal	7.84E+00 Normal	1.15E+01 Normal	2.20E+00 LogNormal	
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00	5.00 10.00	5.00 10.00	5.00 10.00	
Average Repair Time (Min Qty, Max Qty)	1.53E+00 4.59E-01	1.57E+01 4.70E+00	2.29E+01 6.88E+00	4.40E+00 1.32E+00	
CV or beta (Min Qty, Max Qty)	0.86 0.86	0.41 0.41	0.51 0.51	0.36 0.36	
Quantity Unit:	Each	Each	Each	Each	
LifeSafety Hazard:					
Potential non-collapse casualties? (Yes / No)	NO	NO	NO	NO	
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable	Not Applicable	Not Applicable	Not Applicable	
Serious Injury (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00	0% 0.00	
Loss of Life (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00	0% 0.00	
Post-event Tagging Flag:	NO	NO	NO	NO	
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00	0% 0.00	
Comments:	None				
Date Created:	Not Given				
Approved (YES / NO)?	By User				
Official (YES / NO) ?	By User				
Author:	Not Given				
Revisions:	None				

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

D1014.022

Hydraulic Elevator – Applies to most California Installations prior to 1976, most western states installations prior to 1982 and most U.S installations prior to 1998.
Costing per elevator. Elevator demand parameter shall be defined as the peak floor acceleration at the first floor. The elevator fragility for a multiple story building should only be entered once on the first floor.

Line 418

Construction Quality:	Any				
Seismic Installation Conditions:	Any				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Peak Floor Acceleration	g			
Number of Damage States:	4				
Damage State:	DS1	DS2	DS3	DS4	
Type of Damage State:	Simultaneous	Simultaneous	Simultaneous	Simultaneous	
DS Hierarchy	Simul(DS1,DS2,DS3,DS4)				
Descriptions	Damaged controls.	Damaged vane and hoist-way switches, and or bent cab stabilizers, and or damaged car guide shoes.	Damaged entrance and car door, and or flooring damage.	Oil leak in hydraulic line, and or hydraulic tank failure.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		BLDG
Demand Location (floor above?)		No

Illustrations

none	none	none	none	
0.30	0.49	0.44	0.37	

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.3	0.3	0.3	0.3	
Data dispersion, β_d :	0.28	Not Specified	Not Specified	Not Specified	
Uncertainty, β_u :	0.1	Not Specified	Not Specified	Not Specified	
Total Dispersion, β :	0.3	0.3	0.3	0.3	
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Multiple repairs possible (% change of each): Repair damaged controls (100%)	Multiple repairs possible (% change of each): Repair damaged vane and hoist-way switches (41%), and or repair bent cab stabilizers (41%), and or repair damaged car guide shoes (41%).	Multiple repairs possible (% change of each): Repair damage to cab door (68%), and or repair cab flooring (46%)	Multiple repairs possible (% change of each): Repair oil leak in hydraulic line (27%), and or hydraulic tank failure (81%)	

Long Lead Time (Yes / No)

NO NO YES NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	4.00E+02	8.00E+02	2.50E+03	4.20E+03	8.20E+03	1.05E+04	4.00E+03	1.20E+04	1.60E+04	2.00E+03	2.30E+03	3.60E+03			
Best fit mean:	8.68E+02			7.63E+03			1.07E+04			2.54E+03					
Best Fit Distribution:	LogNormal			Normal			Normal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00			5.00 10.00			5.00 10.00					
Average Repair Cost (Min Qty, Max Qty)	1.60E+03 0.82			1.64E+04 0.32			2.40E+04 0.44			4.60E+03 0.25			1.38E+03 0.25		
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	4.00E-01	8.00E-01	2.50E+00	4.20E+00	8.20E+00	1.05E+01	4.00E+00	1.20E+01	1.60E+01	2.00E+00	2.30E+00	3.60E+00			
Best fit mean:	8.00E-01			8.20E+00			1.20E+01			2.30E+00					
Best Fit Distribution:	LogNormal			Normal			Normal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00			5.00 10.00			5.00 10.00					
Average Repair Time (Min Qty, Max Qty)	1.60E+00 0.86			1.64E+01 0.41			2.40E+01 0.51			4.60E+00 0.36			1.38E+00 0.36		
CV or beta (Min Qty, Max Qty)															
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					
Post-event Tagging Flag:	NO			NO			NO			NO					
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00			0% 0.00			0% 0.00					

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D2021.011a

Cold or Hot Potable - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC A or B, PIPING FRAGILITY

Potable water. Costing based upon 1000 ft segments.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

SDC A or B

LF 1000

Peak Floor Acceleration

2

DS1

Sequential

Seq(DS1,DS2)

Minor leakage at flange connections - 1 leak per 1000 feet of pipe.

Pipe Break - 1 break per 1000 feet of pipe.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO

Yes

DS2

Illustrations

Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.5

Not Specified

Not Specified

0.4

NO

NO

Not Rated

Not Rated

Not Rated

Not Rated

Retighten flange bolts at leaking joints. One joint per 1000 LF.

2.6

Not Specified

Not Specified

0.4

Replace 20 foot sections of pipe where breaks occur. One repair per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

9.00E+01

2.90E+02

7.40E+02

1.50E+03

2.65E+03

4.35E+03

2.79E+02

LogNormal

1.00

4.00

3.19E+02

2.61E+02

0.76

0.76

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

9.53E-02

3.07E-01

7.84E-01

1.59E-01

2.81E-01

4.61E-01

3.07E-01

LogNormal

1.00

4.00

3.38E-01

2.76E-01

0.80

0.80

Each (1000 ft pipe)

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

NO

0%

0.00

Consequence is for piping only. Enter floor wetting consequence seperately. Cost includes allowance for MEP relocation to perform work.

Not Given

By User

By User

Not Given

2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification D2021.012b
NISTIR Name Cold or Hot Potable - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC C, BRACING FRAGILITY
Description Potable water. Costing based upon 1000 ft segments.

Line 703

Construction Quality:	Normal					<div>Quantity RoundingRound Qty?NO Allow sum by floor or building?NO Demand Location (floor above)?Yes</div>
Seismic Installation Conditions:	SDC C					
Fragility Unit of Measure:	LF 1000					
Demand Parameter (unit):	Peak Floor Acceleration	g				
Number of Damage States:	2					
Damage State:	DS1	DS2				
Type of Damage State:	Sequential	Sequential				
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Lateral Brace Failure - 1 failure per 1000 feet of pipe.		Vertical Brace Failure - 1 failure per 1000 feet of pipe.			

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations					
	none	none			
Damage State Probability:	1.00	1.00			

Fragility Parameters					
Median Demand, θ :	1.5	2.6			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Retighten flange bolts at leaking joints. One joint per 1000 LF. Replace 20 foot sections of pipe where breaks occur. One repair per 1000 LF..				

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀ P ₅₀ P ₉₀			P ₁₀ P ₅₀ P ₉₀			P ₁₀ P ₅₀ P ₉₀			P ₁₀ P ₅₀ P ₉₀			P ₁₀ P ₅₀ P ₉₀		
Repair Cost by Damage State:	1.80E+02 3.80E+02 8.30E+02			3.60E+03 3.80E+03 4.25E+03											
Best fit mean:	3.83E+02			3.87E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 4.00			1.00 4.00											
Average Repair Cost (Min Qty, Max Qty)	4.18E+02 3.42E+02			4.18E+03 3.42E+03											
CV or beta (Min Qty, Max Qty)	0.60 0.60			0.07 0.07											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀ P ₅₀ P ₉₀			P ₁₀ P ₅₀ P ₉₀			P ₁₀ P ₅₀ P ₉₀			P ₁₀ P ₅₀ P ₉₀			P ₁₀ P ₅₀ P ₉₀		
Repair Time by Damage State:	1.91E-01 4.02E-01 8.79E-01			3.81E-01 4.02E-01 4.50E-01											
Best fit mean:	4.02E-01			4.02E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 4.00			1.00 4.00											
Average Repair Time (Min Qty, Max Qty)	4.43E-01 3.62E-01			8.05E-01 2.01E-01											
CV or beta (Min Qty, Max Qty)	0.65 0.65			0.26 0.26											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										
Comments: Consequence is for piping only. Enter floor wetting consequence seperately. Cost includes allowance for MEP relocation to perform work.															
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	2016-10-26 - Corrected consequence descriptions.														
Root Cost Multiplier: 1															

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

D2021.013a

Cold or Hot Potable - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC D, E, or F, PIPING FRAGILITY
Potable water. Costing based upon 1000 ft segments.

Line 704

Construction Quality: Normal

Seismic Installation Conditions: SDC D, E or F (high seismic design)

Fragility Unit of Measure: LF 1000

Demand Parameter (unit): Peak Floor Acceleration g

Number of Damage States: 2

Damage State: DS1DS2

Type of Damage State: SequentialSequential

DS Hierarchy: Seq(DS1,DS2)

Descriptions: Minor leakage at flange connections - 1 leak per 1000 feet of pipe. Pipe Break - 1 break per 1000 feet of pipe.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

Long Lead Time (Yes / No)

Repair Costs:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Cost by Damage State:	9.00E+01	2.90E+02	7.40E+02	1.50E+03	2.65E+03	4.35E+03									
Best fit mean:	2.79E+02			2.80E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	3.19E+02 2.61E+02			2.92E+03 2.39E+03											
CV or beta (Min Qty, Max Qty)	0.76 0.76			0.41 0.41											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Time by Damage State:	9.53E-02	3.07E-01	7.84E-01	1.59E+00	2.81E+00	4.61E+00									
Best fit mean:	3.07E-01			2.81E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00 10.00			3.00 10.00											
Average Repair Time (Min Qty, Max Qty)	3.38E-01 2.76E-01			3.09E+00 2.53E+00											
CV or beta (Min Qty, Max Qty)	0.80 0.80			0.48 0.48											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments: Consequence is for piping only. Enter floor wetting consequence seperately. Cost includes allowance for MEP relocation to perform work.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: 2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D2021.013b
Cold or Hot Potable - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC D, E, or F, BRACING FRAGILITY
Potable water. Costing based upon 1000 ft segments.

Line 705

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

SDC D, E or F (high seismic design)

LF 1000

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Lateral Brace Failure - 1 failure per 1000 feet of pipe.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO

Yes

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.5

Not Specified

Not Specified

0.4

NO

NO

Not Rated

Not Rated

Not Rated

Not Rated

Retighten leaking joints. One joint per 1000 LF.

Replace 20 ft section of pipe at leaking joints. One repair per 1000 LF.

Long Lead Time (Yes / No) NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.80E+02

3.80E+02

8.30E+02

3.83E+02

3.00

10.00

4.18E+02

3.42E+02

0.60

0.60

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.91E-01

4.02E-01

8.79E-01

4.02E-01

3.00

10.00

4.43E-01

3.62E-01

0.65

0.65

Each (1000 ft pipe)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Consequence is for piping only. Enter floor wetting consequence seperately. Cost includes allowance for MEP relocation to perform work.

Not Given

By User

By User

Not Given

2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier: 1

2016-10-26 - Corrected consequence descriptions.

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D2021.014b

Cold or Hot Potable - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC D, E, or F (OSHDP or sim), BRACING FRAGILITY

Potable water. Costing based upon 1000 ft segments.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Special Regulation (e.g. OSHPD) for piping installations

SDC D, E or F (high seismic design)

LF 1000

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Lateral Brace Failure - 1 failure per 1000 feet of pipe.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO

Yes

Illustrations

none

1.00

1.5

Not Specified

Not Specified

0.4

NO

NO

Not Rated

Not Rated

Not Rated

Not Rated

Retighten leaking joints. One joint per 1000 LF.

Replace 20 ft section of pipe at leaking joints. One repair per 1000 LF.

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

NO

NO

Not Rated

Not Rated

Not Rated

Not Rated

Retighten leaking joints. One joint per 1000 LF.

Replace 20 ft section of pipe at leaking joints. One repair per 1000 LF.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.80E+02

3.80E+02

8.30E+02

3.83E+02

LogNormal

3.00

10.00

4.18E+02

3.42E+02

0.60

0.60

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.91E-01

4.02E-01

8.79E-01

4.02E-01

LogNormal

3.00

10.00

4.43E-01

3.62E-01

0.65

0.65

Each (1000 ft pipe)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Consequence is for piping only. Enter floor wetting consequence seperately. Cost includes allowance for MEP relocation to perform work.

Not Given

By User

By User

Not Given

2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification D2021.021a
NISTIR Name Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC A or B, PIPING FRAGILITY
Description Potable water. Costing based upon 1000 ft segments.

Line 708

Construction Quality:	Normal				
Seismic Installation Conditions:	SDC A or B				
Fragility Unit of Measure:	LF 1000				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	2				
Damage State:	DS1	DS2			
Type of Damage State:	Sequential				
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Minor leakage at flange connections - 1 leak per 1000 feet of pipe. Pipe Break - 1 break per 1000 feet of pipe.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations					
	none	none			
Damage State Probability:	1.00	1.00			

Fragility Parameters					
Median Demand, θ :	1.5	2.6			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Replace failed supports. One repair per 1000 LF. Replace failed 60 ft pipe sections including supports. One repair per 1000 LF.				

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.50E+02	3.50E+02	8.00E+02	1.80E+03	3.35E+03	5.35E+03									
Best fit mean:	3.48E+02			3.21E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	7.00E+02 2.10E+02			6.70E+03 2.01E+03											
CV or beta (Min Qty, Max Qty)	0.65 0.65			0.40 0.40											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.59E-01	3.71E-01	8.47E-01	1.91E+00	3.55E+00	5.66E+00									
Best fit mean:	3.71E-01			3.55E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Time (Min Qty, Max Qty)	7.41E-01 2.22E-01			7.09E+00 2.13E+00											
CV or beta (Min Qty, Max Qty)	0.70 0.70			0.47 0.47											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments: Consequence is for piping only. Enter floor wetting consequence seperately. Cost includes allowance for MEP relocation to perform work.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2016-10-26 - Corrected consequence descriptions.
Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

D2021.022a

Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC C, PIPING FRAGILITY
Potable water. Costing based upon 1000 ft segments.

Line 709

Construction Quality:	Normal					<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? Yes</div>
Seismic Installation Conditions:	SDC C					
Fragility Unit of Measure:	LF 1000					
Demand Parameter (unit):	Peak Floor Acceleration	g				
Number of Damage States:	2					
Damage State:	DS1	DS2				
Type of Damage State:	Sequential	Sequential				
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Minor leakage at flange connections - 1 leak per 1000 feet of pipe.					
	Pipe Break - 1 break per 1000 feet of pipe.					

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations					
	none	none			
Damage State Probability:	1.00	1.00			

Fragility Parameters					
Median Demand, θ :	1.5	2.6			
Data dispersion, β_d :	0.4	0.40			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Retighten leaking joints. One joint per 1000 LF. Replace 20 ft section of pipe at leaking joints. One repair per 1000 LF.				

Long Lead Time (Yes / No)	NO						NO								
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.50E+02	3.50E+02	8.00E+02	1.80E+03	3.35E+03	5.35E+03									
Best fit mean:	3.48E+02			3.21E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00	5.00		10.00									
Average Repair Cost (Min Qty, Max Qty)	7.00E+02		2.10E+02	6.70E+03		2.01E+03									
CV or beta (Min Qty, Max Qty)	0.65		0.65	0.40		0.40									
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.59E-01	3.71E-01	8.47E-01	1.91E+00	3.55E+00	5.66E+00									
Best fit mean:	3.71E-01			3.55E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00	5.00		10.00									
Average Repair Time (Min Qty, Max Qty)	7.41E-01		2.22E-01	7.09E+00		2.13E+00									
CV or beta (Min Qty, Max Qty)	0.70		0.70	0.47		0.47									
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										
Comments:	Consequence is for piping only. Enter floor wetting consequence seperately. Cost includes allowance for MEP relocation to perform work.														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	2016-10-26 - Corrected consequence descriptions.														
	Root Cost Multiplier: 1														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

D2021.023a

Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC D,E,F, PIPING FRAGILITY
Potable water. Costing based upon 1000 ft segments.

Line 710

Construction Quality:	Normal				<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? Yes</div>	
Seismic Installation Conditions:	SDC D, E or F (high seismic design)					
Fragility Unit of Measure:	LF 1000					
Demand Parameter (unit):	Peak Floor Accelerationg					
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Minor leakage at flange connections - Pipe Break - 1 break per 1000 feet of pipe. 1 leak per 1000 feet of pipe.					

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations

none	none			
1.00	1.00			

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	2.25	4.1		
Data dispersion, β_d :	0.4	0.40		
Uncertainty, β_u :	Not Specified	Not Specified		
Total Dispersion, β :	0.4	0.4		
Correlation (Yes / No)	NO			
Directionality (Yes / No)	NO			
Quality Ratings				
Data Quality	Not Rated			
Data Relevance	Not Rated			
Documentation Quality	Not Rated			
Rationality	Not Rated			
Consequence Functions				
Repair Description	Replace failed supports. One repair per 1000 LF.			

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.50E+02	3.50E+02	8.00E+02	1.80E+03	3.35E+03	5.35E+03									
Best fit mean:	3.48E+02			3.21E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00	5.00		10.00									
Average Repair Cost (Min Qty, Max Qty)	7.00E+02		2.10E+02	6.70E+03		2.01E+03									
CV or beta (Min Qty, Max Qty)	0.65		0.65	0.40		0.40									
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.59E-01	3.71E-01	8.47E-01	1.91E+00	3.55E+00	5.66E+00									
Best fit mean:	3.71E-01			3.55E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00	5.00		10.00									
Average Repair Time (Min Qty, Max Qty)	7.41E-01		2.22E-01	7.09E+00		2.13E+00									
CV or beta (Min Qty, Max Qty)	0.70		0.70	0.47		0.47									
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00									
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00									
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	0%		0.00									

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification D2021.024a

NISTIR Name Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC D,E,F (OSPHD or sim), PIPING FRAGILITY

Description Potable water. Costing based upon 1000 ft segments.

Line 712

Construction Quality:	Special Regulation (e.g. OSHPD) for piping installations				
Seismic Installation Conditions:	SDC D, E or F (high seismic design)				
Fragility Unit of Measure:	LF 1000				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	2				
Damage State:	DS1	DS2			
Type of Damage State:	Sequential				
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Minor leakage at flange connections - 1 leak per 1000 feet of pipe. Pipe Break - 1 break per 1000 feet of pipe.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations					
	none	none			
Damage State Probability:	1.00	1.00			

Fragility Parameters					
Median Demand, θ :	2.25	4.1			
Data dispersion, β_d :	0.4	0.40			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Replace failed supports. One repair per 1000 LF.				

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.50E+02	3.50E+02	8.00E+02	1.80E+03	3.35E+03	5.35E+03									
Best fit mean:	3.48E+02			3.21E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00	5.00		10.00									
Average Repair Cost (Min Qty, Max Qty)	7.00E+02		2.10E+02	6.70E+03		2.01E+03									
CV or beta (Min Qty, Max Qty)	0.65		0.65	0.40		0.40									
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.59E-01	3.71E-01	8.47E-01	1.91E+00	3.55E+00	5.66E+00									
Best fit mean:	3.71E-01			3.55E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00	5.00		10.00									
Average Repair Time (Min Qty, Max Qty)	7.41E-01		2.22E-01	7.09E+00		2.13E+00									
CV or beta (Min Qty, Max Qty)	0.70		0.70	0.47		0.47									
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00									
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00									
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	0%		0.00									

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification D2021.024b
NISTIR Name Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC D,E,F (OSPHD or sim), BRACING FRAGILITY
Description Potable water. Costing based upon 1000 ft segments.

Line 713

Construction Quality:	Special Regulation (e.g. OSHPD) for piping installations				
Seismic Installation Conditions:	SDC D, E or F (high seismic design)				
Fragility Unit of Measure:	LF 1000				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	2				
Damage State:	DS1	DS2			
Type of Damage State:	Sequential Sequential				
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Lateral Brace Failure - 1 failure per 1000 feet of pipe. Vertical Brace Failure - 1 failure per 1000 feet of pipe.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations					
	none	none			
Damage State Probability:	1.00	1.00			

Fragility Parameters					
Median Demand, θ :	1.5	2.25			
Data dispersion, β_d :	0.4	0.40			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Retighten flange bolts at leaking joints. Replace 20 foot sections of pipe where breaks occur. One joint per 1000 LF. One repair per 1000 LF.				

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀ P ₅₀ P ₉₀			P ₁₀ P ₅₀ P ₉₀			P ₁₀ P ₅₀ P ₉₀			P ₁₀ P ₅₀ P ₉₀			P ₁₀ P ₅₀ P ₉₀		
Repair Cost by Damage State:	1.50E+02 3.50E+02 8.00E+02			1.50E+02 3.50E+02 8.00E+02											
Best fit mean:	3.48E+02			3.48E+02											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	7.00E+02 2.10E+02			7.00E+02 2.10E+02											
CV or beta (Min Qty, Max Qty)	0.65 0.65			0.65 0.65											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀ P ₅₀ P ₉₀			P ₁₀ P ₅₀ P ₉₀			P ₁₀ P ₅₀ P ₉₀			P ₁₀ P ₅₀ P ₉₀			P ₁₀ P ₅₀ P ₉₀		
Repair Time by Damage State:	1.59E-01 3.71E-01 8.47E-01			1.59E-01 3.71E-01 8.47E-01											
Best fit mean:	3.71E-01			3.71E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Time (Min Qty, Max Qty)	7.41E-01 2.22E-01			7.41E-01 2.22E-01											
CV or beta (Min Qty, Max Qty)	0.70 0.70			0.70 0.70											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											
Comments: Consequence is for piping only. Enter floor wetting consequence seperately. Cost includes allowance for MEP relocation to perform work.															
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	2016-10-26 - Corrected consequence descriptions.														
Root Cost Multiplier: 1															

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

D2022.011a

Heating hot Water Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC A or B, PIPING FRAGILITY
Heating water. Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Line 714

Construction Quality:	Normal				
Seismic Installation Conditions:	SDC A or B (no seismic design)				
Fragility Unit of Measure:	LF 1000				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	2				
Damage State:	DS1	DS2			
Type of Damage State:	Sequential				
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Small Leakage at joints - 1 leak per 1000 feet of pipe. Large Leakage w/ major repair - 1 leak per 1000 feet of pipe.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations					
	none	none			
Damage State Probability:	1.00	1.00			

Fragility Parameters					
Median Demand, θ :	0.55	1.1			
Data dispersion, β_d :	0.4	0.40			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	By User	By User			

Correlation (Yes / No) NO
Directionality (Yes / No) NO
Quality Ratings
Data Quality Not Rated
Data Relevance Not Rated
Documentation Quality Not Rated
Rationality Not Rated
Consequence Functions
Repair Description Retighten flange bolts at leaking joints. One repair per 1000 LF. Replace 20 foot sections of pipe where breaks occur. One repair per 1000 LF.

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	9.00E+01	2.90E+02	7.40E+02	1.50E+03	2.65E+03	4.35E+03									
Best fit mean:	2.79E+02			2.60E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00	4.00		1.00	4.00										
Average Repair Cost (Min Qty, Max Qty)	3.19E+02	2.61E+02		2.92E+03	2.39E+03										
CV or beta (Min Qty, Max Qty)	0.76	0.76		0.41	0.41										
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.53E-02	3.07E-01	7.84E-01	1.59E-01	2.81E-01	4.61E-01									
Best fit mean:	3.07E-01			2.81E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00	4.00		1.00	4.00										
Average Repair Time (Min Qty, Max Qty)	3.38E-01	2.76E-01		5.61E-01	1.40E-01										
CV or beta (Min Qty, Max Qty)	0.80	0.80		0.48	0.48										
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										

Root Cost Multiplier: 1

Root Cost Multiplier: 1

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.		
None	Root Cost Multiplier:	1
By User		
By User		
Not Given		
2016-10-26 - Corrected consequence descriptions.		

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

D2022.012b
Heating hot Water Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC C, BRACING FRAGILITY
Heating water. Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Line 717

Construction Quality:	Normal			<div>Quantity Rounding</div> <div>Round Qty?</div> <div>NO</div> <div>Allow sum by floor or building?</div> <div>NO</div> <div>Demand Location (floor above?)</div> <div>Yes</div>
Seismic Installation Conditions:	SDC C (low seismic design)			
Fragility Unit of Measure:	LF 1000			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	2			
Damage State:	DS1		DS2	
Type of Damage State:	Sequential		Sequential	
DS Hierarchy	Seq(DS1,DS2)			
Descriptions	Isolated support failure w/o leakage - 0.5 supports fail per 1000 feet of pipe (assuming supports every 20 feet).			
	Multiple supports failure and 60 feet of pipe fail per 1000 feet of pipe (assuming supports every 20 feet).			

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations

none	none			
1.00	1.00			

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	1.2	2.4		
Data dispersion, β_d :	0.5	0.50		
Uncertainty, β_u :	Not Specified	Not Specified		
Total Dispersion, β_t :	By User	By User		
Correlation (Yes / No)	NO			
Directionality (Yes / No)	NO			
Quality Ratings				
Data Quality	Not Rated			
Data Relevance	Not Rated			
Documentation Quality	Not Rated			
Rationality	Not Rated			
Consequence Functions				
Repair Description	Retighten flange bolts at leaking joints. One repair per 1000 LF. Replace 20 foot sections of pipe where breaks occur. One repair per 1000 LF.			

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.80E+02	3.80E+02	8.30E+02	3.60E+03	3.80E+03	4.25E+03									
Best fit mean:	3.83E+02			3.87E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 4.00			1.00 4.00											
Average Repair Cost (Min Qty, Max Qty)	4.18E+02 3.42E+02			4.18E+03 3.42E+03											
CV or beta (Min Qty, Max Qty)	0.60 0.60			0.07 0.07											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.91E-01	4.02E-01	8.79E-01	3.81E-01	4.02E-01	4.50E-01									
Best fit mean:	4.02E-01			4.02E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 4.00			1.00 4.00											
Average Repair Time (Min Qty, Max Qty)	4.43E-01 3.62E-01			8.05E-01 2.01E-01											
CV or beta (Min Qty, Max Qty)	0.65 0.65			0.26 0.26											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D2022.013b

Heating hot Water Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC D, E, or F, BRACING FRAGILITY

Heating water. Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Line 719

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Construction Quality:

Normal

Seismic Installation Conditions:

SDC D, E, F (high seismic design)

Fragility Unit of Measure:

LF 1000

Demand Parameter (unit):

Peak Floor Acceleration

g

Number of Damage States:

1

Damage State:

DS1

Type of Damage State:

Sequential

DS Hierarchy

Seq(DS1)

Descriptions

Isolated support failure w/o leakage -
0.5 supports fail per 1000 feet of pipe
(assuming supports every 20 feet).

Illustrations

Damage State Probability:

1.00

Fragility Parameters

Median Demand, θ :

2.25

Data dispersion, β_d :

0.4

Uncertainty, β_u :

Not Specified

Total Dispersion, β :

By User

Correlation (Yes / No)

NO

Directionality (Yes / No)

NO

Quality Ratings

Data Quality

Not Rated

Data Relevance

Not Rated

Documentation Quality

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Replace failed supports. One repair per 1000 LF.

Replace failed 60 ft pipe sections including supports. One repair per 1000 LF.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

1.80E+02

3.80E+02

8.30E+02

Best fit mean:

3.83E+02

Best Fit Distribution:

LogNormal

Quantity Plateau (Min Qty, Max Qty)

3.00

10.00

Average Repair Cost (Min Qty, Max Qty)

4.18E+02

3.42E+02

CV or beta (Min Qty, Max Qty)

0.60

0.60

Quantity Unit:

Each (1000 ft pipe)

Repair Time:

Repair Time by Damage State:

1.91E-01

4.02E-01

8.79E-01

Best fit mean:

4.02E-01

Best Fit Distribution:

LogNormal

Quantity Plateau (Min Qty, Max Qty)

3.00

10.00

Average Repair Time (Min Qty, Max Qty)

4.43E-01

3.62E-01

CV or beta (Min Qty, Max Qty)

0.65

0.65

Quantity Unit:

Each (1000 ft pipe)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

NO

Casualty-affected Planar Area (sf) per Normative Unit:

Not Applicable

Serious Injury (Median, Dispersion)

0%

0.00

Loss of Life (Median, Dispersion)

0%

0.00

Post-event Tagging Flag:

NO

Unsafe Placard Trigger (Median, Dispersion)

0%

0.00

Comments:

Consequence is for piping only. Enter floor wetting consequence seperately. Cost includes allowance for MEP relocation to perform work.

Date Created:

None

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

D2022.014a

Heating hot Water Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC D, E, or F (OSHDP or sim), PIPING FRAGILITY
Heating water. Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Line 720

Construction Quality: Special Regulations (e.g. OSHPD) for Piping Installations
Seismic Installation Conditions: SDC D, E, F (high seismic design)
Fragility Unit of Measure: LF 1000
Demand Parameter (unit): Peak Floor Acceleration g
Number of Damage States: 2
Damage State: DS1 DS2
Type of Damage State: Sequential Sequential
DS Hierarchy: Seq(DS1,DS2)
Descriptions: Small Leakage at joints - 1 leak per 1000 feet of pipe. Large Leakage w/ major repair - 1 leak per 1000 feet of pipe.

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations

none	none			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.55	1.1			
Data dispersion, β_d :	0.4	0.40			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	By User	By User			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Replace failed supports. One repair per 1000 LF.	Replace failed 60 ft pipe sections including supports. One repair per 1000 LF.			

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	9.00E+01	2.90E+02	7.40E+02	1.50E+03	2.65E+03	4.35E+03									
Best fit mean:	2.79E+02			2.80E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00	10.00		3.00	10.00										
Average Repair Cost (Min Qty, Max Qty)	3.19E+02	2.61E+02		2.92E+03	2.39E+03										
CV or beta (Min Qty, Max Qty)	0.76	0.76		0.41	0.41										
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.53E-02	3.07E-01	7.84E-01	1.59E+00	2.81E+00	4.61E+00									
Best fit mean:	3.07E-01			2.81E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	3.00	10.00		3.00	10.00										
Average Repair Time (Min Qty, Max Qty)	3.38E-01	2.76E-01		3.09E+00	2.53E+00										
CV or beta (Min Qty, Max Qty)	0.80	0.80		0.48	0.48										
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										

Comments: Consequence is for piping only. Enter floor wetting consequence seperately. Cost includes allowance for MEP relocation to perform work.
Date Created: None
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2016-10-26 - Corrected consequence descriptions.
Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D2022.014b

Heating hot Water Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC D, E, or F (OSHPD or sim), BRACING FRAGILITY

Heating water. Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Special Regulations (e.g. OSHPD) for Piping Installations

SDC D, E, F (high seismic design)

LF 1000

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Isolated support failure w/o leakage - 0.5 supports fail per 1000 feet of pipe (assuming supports every 20 feet).

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO

Yes

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

3

0.4

Not Specified

By User

NO

NO

Not Rated

Not Rated

Not Rated

Not Rated

Replace failed supports. One repair per 1000 LF.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Time:

LifeSafety Hazard:

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.80E+02

3.80E+02

8.30E+02

3.83E+02

LogNormal

3.00

10.00

4.18E+02

3.42E+02

0.60

0.60

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.91E-01

4.02E-01

8.79E-01

4.02E-01

LogNormal

3.00

10.00

4.43E-01

3.62E-01

0.65

0.65

Each (1000 ft pipe)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Consequence is for piping only. Enter floor wetting consequence seperately. Cost includes allowance for MEP relocation to perform work.

None

By User

By User

Not Given

2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

D2022.021a

Heating hot Water Piping - Large Diameter Welded Steel - (greater than 2.5 inches in diameter), SDC A or B, PIPING FRAGILITY
Heating water. Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Line 722

Construction Quality:	Normal				<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above)?Yes</div>
Seismic Installation Conditions:	SDC A or B (no seismic design)				
Fragility Unit of Measure:	LF 1000				
Demand Parameter (unit):	Peak Floor Accelerationg				
Number of Damage States:	2				
Damage State:	DS1		DS2		
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Minor leakage at flange connections - Pipe Break - 1 break per 1000 feet of pipe. 1 leak per 1000 feet of pipe.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations

none	none			
1.00	1.00			

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	1.5	2.6		
Data dispersion, β_d :	0.4	0.40		
Uncertainty, β_u :	Not Specified	Not Specified		
Total Dispersion, β_t :	By User	By User		
Correlation (Yes / No)	NO			
Directionality (Yes / No)	NO			
Quality Ratings				
Data Quality	Not Rated			
Data Relevance	Not Rated			
Documentation Quality	Not Rated			
Rationality	Not Rated			
Consequence Functions				
Repair Description	Replace failed supports. One repair per 1000 LF.			

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.50E+02	3.50E+02	8.00E+02	1.80E+03	3.35E+03	5.35E+03									
Best fit mean:	3.48E+02			3.21E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00	5.00		10.00									
Average Repair Cost (Min Qty, Max Qty)	7.00E+02		2.10E+02	6.70E+03		2.01E+03									
CV or beta (Min Qty, Max Qty)	0.65		0.65	0.40		0.40									
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.59E-01	3.71E-01	8.47E-01	1.91E+00	3.55E+00	5.66E+00									
Best fit mean:	3.71E-01			3.55E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00	5.00		10.00									
Average Repair Time (Min Qty, Max Qty)	7.41E-01		2.22E-01	7.09E+00		2.13E+00									
CV or beta (Min Qty, Max Qty)	0.70		0.70	0.47		0.47									
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00									
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00									
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	0%		0.00									

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

D2022.023a

Heating hot Water Piping - Large Diameter Welded Steel - (greater than 2.5 inches in diameter), SDC D, E, or F, PIPING FRAGILITY
Heating water. Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Line 724

Construction Quality: Normal

Seismic Installation Conditions: SDC D, E, F (high seismic design)

Fragility Unit of Measure: LF 1000

Demand Parameter (unit): Peak Floor Acceleration g

Number of Damage States: 2

Damage State: DS1DS2

Type of Damage State: SequentialSequential

DS Hierarchy: Seq(DS1,DS2)

Descriptions: Minor leakage at flange connections - 1 leak per 1000 feet of pipe. Pipe Break - 1 break per 1000 feet of pipe.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β_t :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

Long Lead Time (Yes / No)

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.50E+02	3.50E+02	8.00E+02	1.80E+03	3.35E+03	5.35E+03									
Best fit mean:	3.48E+02			3.21E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00	5.00		10.00									
Average Repair Cost (Min Qty, Max Qty)	7.00E+02		2.10E+02	6.70E+03		2.01E+03									
CV or beta (Min Qty, Max Qty)	0.65		0.65	0.40		0.40									
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.59E-01	3.71E-01	8.47E-01	1.91E+00	3.55E+00	5.66E+00									
Best fit mean:	3.71E-01			3.55E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00	5.00		10.00									
Average Repair Time (Min Qty, Max Qty)	7.41E-01		2.22E-01	7.09E+00		2.13E+00									
CV or beta (Min Qty, Max Qty)	0.70		0.70	0.47		0.47									
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00									
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00									
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	0%		0.00									

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D2022.023b

Heating hot Water Piping - Large Diameter Welded Steel - (greater than 2.5 inches in diameter), SDC D, E, or F, BRACING FRAGILITY

Heating water. Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

SDC D, E, F (high seismic design)

LF 1000

Peak Floor Acceleration

2

DS1

Sequential

Seq(DS1,DS2)

Lateral Brace Failure - 1 failure per 1000 foot of pipe.

Vertical Brace Failure - 1 failure per 1000 feet of pipe.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO

Yes

DS2

Sequential

Not Specified By User

Not Specified By User

Illustrations

Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.5

2.25

0.4

0.40

Not Specified By User

Not Specified By User

NO

NO

Not Rated

Not Rated

Not Rated

Not Rated

Replace failed supports. One repair per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.50E+02

3.50E+02

8.00E+02

1.50E+02

3.50E+02

8.00E+02

3.48E+02

LogNormal

5.00

10.00

7.00E+02

0.65

Each (1000 ft pipe)

3.71E-01

LogNormal

5.00

10.00

7.41E-01

0.70

Each (1000 ft pipe)

NO

Not Applicable

0%

0.00

NO

0%

0.00

Consequence is for piping only. Enter floor wetting consequence seperately. Cost includes allowance for MEP relocation to perform work.

None

By User

By User

Not Given

2016-10-26 - Corrected consequence descriptions.

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.59E-01

3.71E-01

8.47E-01

1.59E-01

3.71E-01

8.47E-01

3.71E-01

LogNormal

5.00

10.00

7.41E-01

0.70

Each (1000 ft pipe)

3.71E-01

LogNormal

5.00

10.00

7.41E-01

0.70

Each (1000 ft pipe)

NO

Not Applicable

0%

0.00

NO

0%

0.00

Root Cost Multiplier:

1

Comments:	Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.		
Date Created:	None	Root Cost Multiplier:	1
Approved (YES / NO)?	By User		
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	2016-10-26 - Corrected consequence descriptions.		

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D2022.024b

Heating hot Water Piping - Large Diameter Welded Steel - (greater than 2.5 inches in diameter), SDC D, E, or F (OSHDP or sim), BRACING FRAGILITY

Heating water. Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Special Regulation (e.g. OSHPD) for Piping Installations

SDC D, E, F (high seismic design)

LF 1000

Peak Floor Acceleration

g

2

DS1

DS2

Sequential

Seq(DS1,DS2)

Lateral Brace Failure - 1 failure per 1000 foot of pipe.

Vertical Brace Failure - 1 failure per 1000 feet of pipe.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO

Yes

Illustrations

none

none

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.00

1.00

1.5

0.4

Not Specified By User

2.25

0.40

Not Specified By User

NO

NO

Not Rated

Not Rated

Not Rated

Not Rated

Replace failed supports. One repair per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.50E+02

3.50E+02

8.00E+02

1.50E+02

3.50E+02

8.00E+02

3.48E+02

LogNormal

5.00

10.00

7.00E+02

0.65

2.10E+02

0.65

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.59E-01

3.71E-01

8.47E-01

1.59E-01

3.71E-01

8.47E-01

3.71E-01

LogNormal

5.00

10.00

7.41E-01

0.70

2.22E-01

0.70

Each (1000 ft pipe)

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

NO

NO

0%

0.00

Consequence is for piping only. Enter floor wetting consequence seperately. Cost includes allowance for MEP relocation to perform work.

None

By User

By User

Not Given

2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification D2031.013b
NISTIR Name Sanitary Waste Piping - Cast Iron w/flexible couplings, SDC D,E,F, BRACING FRAGILITY
Description Costing based upon 1000 ft segments of pipe

Line 730

Construction Quality: Normal

Seismic Installation Conditions: SDC D, E or F (high seismic design)

Fragility Unit of Measure: LF 1000

Demand Parameter (unit): Peak Floor Acceleration g

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1)

Descriptions: Isolated support failure w/o leakage - 0.5 supports fail per 1000 feet of pipe (assuming supports every 20 feet).

Quantity Rounding: NO

Round Qty?: NO

Allow sum by floor or building?: NO

Demand Location (floor above?): Yes

Illustrations					
	none				

Damage State Probability: 1.00

Fragility Parameters

Median Demand, θ : 2.25

Data dispersion, β_d : 0.4

Uncertainty, β_u : Not Specified

Total Dispersion, β : By User

Correlation (Yes / No): NO

Directionality (Yes / No): NO

Quality Ratings

Data Quality: Not Rated

Data Relevance: Not Rated

Documentation Quality: Not Rated

Rationality: Not Rated

Consequence Functions

Repair Description: Replace failed supports - 0.5 per 1000 LF.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.00E+02	4.00E+02	8.50E+02												
Best fit mean:	4.06E+02														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00												
Average Repair Cost (Min Qty, Max Qty)	8.00E+02		2.40E+02												
CV or beta (Min Qty, Max Qty)	0.58		0.58												
Quantity Unit:	Each (1000 ft pipe)														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.12E-01	4.24E-01	9.00E-01												
Best fit mean:	4.24E-01														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00												
Average Repair Time (Min Qty, Max Qty)	8.47E-01		2.54E-01												
CV or beta (Min Qty, Max Qty)	0.63		0.63												
Quantity Unit:	Each (1000 ft pipe)														
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	Consequence is for piping only. Enter floor wetting consequence seperately. Cost includes allowance for MEP relocation to perform work.														
Date Created:	None														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	2016-10-26 - Corrected consequence descriptions.														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification D2031.021a
NISTIR Name Sanitary Waste Piping - Cast Iron w/bell and spigot couplings, SDC A,B, PIPING FRAGILITY
Description Costing based upon 1000 ft segments of pipe

Line 732

Construction Quality: Normal

Seismic Installation Conditions: SDC A or B

Fragility Unit of Measure: LF 1000

Demand Parameter (unit): Peak Floor Acceleration g

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1)

Descriptions: Joints break - 1 break per 1000 feet of pipe.

Quantity Rounding: Round Qty? NO

Allow sum by floor or building? NO

Demand Location (floor above?) Yes

Illustrations

none

1.00

Fragility Parameters

Median Demand, θ : 2.25

Data dispersion, β_d : 0.4

Uncertainty, β_u : Not Specified By User

Total Dispersion, β :

Correlation (Yes / No): NO

Directionality (Yes / No): NO

Quality Ratings

Data Quality: Not Rated

Data Relevance: Not Rated

Documentation Quality: Not Rated

Rationality: Not Rated

Consequence Functions

Repair Description: Replace failed 20 ft pipe sections including supports - one per 1000 LF.

Long Lead Time (Yes / No) NO

Repair Costs:

Repair Cost by Damage State: 1.80E+03 3.35E+03 4.35E+03

Best fit mean: 3.17E+03

Best Fit Distribution: Normal

Quantity Plateau (Min Qty, Max Qty): 5.00 10.00

Average Repair Cost (Min Qty, Max Qty): 6.70E+03 2.01E+03

CV or beta (Min Qty, Max Qty): 0.31 0.31

Quantity Unit: Each (1000 ft pipe)

Repair Time:

Repair Time by Damage State: 1.91E+00 3.55E+00 4.61E+00

Best fit mean: 3.55E+00

Best Fit Distribution: Normal

Quantity Plateau (Min Qty, Max Qty): 5.00 10.00

Average Repair Time (Min Qty, Max Qty): 7.09E+00 2.13E+00

CV or beta (Min Qty, Max Qty): 0.40 0.40

Quantity Unit: Each (1000 ft pipe)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No): NO

Casualty-affected Planar Area (sf) per Normative Unit: Not Applicable

Serious Injury (Median, Dispersion): 0% 0.00

Loss of Life (Median, Dispersion): 0% 0.00

Post-event Tagging Flag: NO

Unsafe Placard Trigger (Median, Dispersion): 0% 0.00

Comments: Consequence is for piping only. Enter floor wetting consequence seperately. Cost includes allowance for MEP relocation to perform work.

Date Created: None

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: 2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D2031.022a

Sanitary Waste Piping - Cast Iron w/bell and spigot couplings, SDC C, PIPING FRAGILITY

Costing based upon 1000 ft segments of pipe

Line 734

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

SDC C

LF 1000

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Isolated support failure w/o leakage -

0.5 supports fail per 1000 feet of pipe

(assuming supports every 20 feet).

Illustrations

none

1.00

1.2

0.5

Not Specified

By User

NO

NO

Not Rated

Not Rated

Not Rated

Not Rated

Replace failed 20 ft pipe sections

including supports - one per 1000 LF.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau

(Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.80E+03

3.35E+03

4.35E+03

3.17E+03

Normal

5.00

10.00

6.70E+03

2.01E+03

0.31

0.31

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau

(Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.91E+00

3.55E+00

4.61E+00

3.55E+00

Normal

5.00

10.00

7.09E+00

2.13E+00

0.40

0.40

LifeSafety Hazard:

Potential non-collapse casualties?

(Yes / No)

Casualty-affected Planar Area (sf)

per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

Consequence is for piping only. Enter floor wetting consequence seperately. Cost includes allowance for MEP relocation to perform work.

None

By User

By User

Not Given

2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier:

1

(Dispersion)	0%	0.00	0%	0.00					
Comments:	Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.								
Date Created:	None								Root Cost Multiplier: 1
Approved (YES / NO)?	By User								
Official (YES / NO) ?	By User								
Author:	Not Given								
Revisions:	2016-10-26 - Corrected consequence descriptions.								

FEMA P-58 Fragility Specification

NISTIR Classification D2031.023a
NISTIR Name Sanitary Waste Piping - Cast Iron w/bell and spigot couplings, SDC D,E,F, PIPING FRAGILITY
Description Costing based upon 1000 ft segments of pipe

Line 736

Construction Quality: Normal

Seismic Installation Conditions: SDC D, E or F (high seismic design)

Fragility Unit of Measure: LF 1000

Demand Parameter (unit): Peak Floor Acceleration g

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1)

Descriptions: Joints break - 1 break per 1000 feet of pipe.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations					
	none				

Damage State Probability: 1.00

Fragility Parameters

Median Demand, θ : 3

Data dispersion, β_d : 0.4

Uncertainty, β_u : Not Specified By User

Total Dispersion, β :

Correlation (Yes / No): NO

Directionality (Yes / No): NO

Quality Ratings

Data Quality: Not Rated

Data Relevance: Not Rated

Documentation Quality: Not Rated

Rationality: Not Rated

Consequence Functions

Repair Description: Replace failed 20 ft pipe sections including supports - one per 1000 LF.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.80E+03	3.35E+03	4.35E+03												
Best fit mean:	3.17E+03														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00												
Average Repair Cost (Min Qty, Max Qty)	6.70E+03		2.01E+03												
CV or beta (Min Qty, Max Qty)	0.31		0.31												
Quantity Unit:	Each (1000 ft pipe)														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.91E+00	3.55E+00	4.61E+00												
Best fit mean:	3.55E+00														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00												
Average Repair Time (Min Qty, Max Qty)	7.09E+00		2.13E+00												
CV or beta (Min Qty, Max Qty)	0.40		0.40												
Quantity Unit:	Each (1000 ft pipe)														
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	Consequence is for piping only. Enter floor wetting consequence seperately. Cost includes allowance for MEP relocation to perform work.														
Date Created:	None														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	2016-10-26 - Corrected consequence descriptions.														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification D2031.023b
NISTIR Name Sanitary Waste Piping - Cast Iron w/bell and spigot couplings, SDC D,E,F, BRACING FRAGILITY
Description Costing based upon 1000 ft segments of pipe

Line 737

Construction Quality: Normal

Seismic Installation Conditions: SDC D, E or F (high seismic design)

Fragility Unit of Measure: LF 1000

Demand Parameter (unit): Peak Floor Acceleration g

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy Seq(DS1)

Descriptions Isolated support failure w/o leakage - 0.5 supports fail per 1000 feet of pipe (assuming supports every 20 feet).

Quantity Rounding Round Qty? NO

Allow sum by floor or building? NO

Demand Location (floor above?) Yes

Illustrations					
	none				

Damage State Probability: 1.00

Fragility Parameters

Median Demand, θ : 2.25

Data dispersion, β_d : 0.4

Uncertainty, β_u : Not Specified By User

Total Dispersion, β :

Correlation (Yes / No) NO

Directionality (Yes / No) NO

Quality Ratings

Data Quality Not Rated

Data Relevance Not Rated

Documentation Quality Not Rated

Rationality Not Rated

Consequence Functions

Repair Description Replace failed supports - 0.5 per 1000 LF.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.00E+02	4.00E+02	1.05E+03												
Best fit mean:	4.23E+02														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00												
Average Repair Cost (Min Qty, Max Qty)	8.00E+02		2.40E+02												
CV or beta (Min Qty, Max Qty)	0.71		0.71												
Quantity Unit:	Each (1000 ft pipe)														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.12E-01	4.24E-01	1.11E+00												
Best fit mean:	4.24E-01														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00												
Average Repair Time (Min Qty, Max Qty)	8.47E-01		2.54E-01												
CV or beta (Min Qty, Max Qty)	0.75		0.75												
Quantity Unit:	Each (1000 ft pipe)														
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	Consequence is for piping only. Enter floor wetting consequence seperately. Cost includes allowance for MEP relocation to perform work.														
Date Created:	None														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	2016-10-26 - Corrected consequence descriptions.														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification D2031.024a
NISTIR Name Sanitary Waste Piping - Cast Iron w/bell and spigot couplings, SDC D,E,F (OSHDP or sim), PIPING FRAGILITY
Description Costing based upon 1000 ft segments of pipe

Line 738

Construction Quality:	Special Regulation (e.g. OSHPD) for piping installations				
Seismic Installation Conditions:	SDC D, E or F (high seismic design)				
Fragility Unit of Measure:	LF 1000				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	1				
Damage State:	DS1				
Type of Damage State:	Sequential				
DS Hierarchy	Seq(DS1)				
Descriptions	Joints break - 1 break per 1000 feet of pipe.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations					
	none				

Damage State Probability:	1.00				
Fragility Parameters					
Median Demand, θ :	3				
Data dispersion, β_d :	0.4				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	By User				
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Replace failed 20 ft pipe sections including supports - one per 1000 LF.				

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.80E+03	3.35E+03	4.35E+03												
Best fit mean:	3.17E+03														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00												
Average Repair Cost (Min Qty, Max Qty)	6.70E+03		2.01E+03												
CV or beta (Min Qty, Max Qty)	0.31		0.31												
Quantity Unit:	Each (1000 ft pipe)														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.91E+00	3.55E+00	4.61E+00												
Best fit mean:	3.55E+00														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00												
Average Repair Time (Min Qty, Max Qty)	7.09E+00		2.13E+00												
CV or beta (Min Qty, Max Qty)	0.40		0.40												
Quantity Unit:	Each (1000 ft pipe)														
LifeSafety Hazard:	NO														
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	Consequence is for piping only. Enter floor wetting consequence seperately. Cost includes allowance for MEP relocation to perform work.														
Date Created:	None														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	2016-10-26 - Corrected consequence descriptions.														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification D2031.024b
NISTIR Name Sanitary Waste Piping - Cast Iron w/bell and spigot couplings, SDC D,E,F (OSHDP or sim), BRACING FRAGILITY
Description Costing based upon 1000 ft segments of pipe

Line 739

Construction Quality: Special Regulation (e.g. OSHDP) for piping installations

Seismic Installation Conditions: SDC D, E or F (high seismic design)

Fragility Unit of Measure: LF 1000

Demand Parameter (unit): Peak Floor Acceleration g

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1)

Descriptions: Isolated support failure w/o leakage - 0.5 supports fail per 1000 feet of pipe (assuming supports every 20 feet).

Quantity Rounding: Round Qty? NO

Allow sum by floor or building? NO

Demand Location (floor above?) Yes

Illustrations

none

1.00

Fragility Parameters

Median Demand, θ : 2.25

Data dispersion, β_d : 0.4

Uncertainty, β_u : Not Specified

Total Dispersion, β : By User

Correlation (Yes / No): NO

Directionality (Yes / No): NO

Quality Ratings

Data Quality: Not Rated

Data Relevance: Not Rated

Documentation Quality: Not Rated

Rationality: Not Rated

Consequence Functions

Repair Description: Retighten flange bolts at leaking joints.

Long Lead Time (Yes / No) NO

Repair Costs:

Repair Cost by Damage State: 2.00E+02 4.00E+02 1.05E+03

Best fit mean: 4.23E+02

Best Fit Distribution: LogNormal

Quantity Plateau (Min Qty, Max Qty): 5.00 10.00

Average Repair Cost (Min Qty, Max Qty): 8.00E+02 2.40E+02

CV or beta (Min Qty, Max Qty): 0.71 0.71

Quantity Unit: Each (1000 ft pipe)

Repair Time:

Repair Time by Damage State: 2.12E-01 4.24E-01 1.11E+00

Best fit mean: 4.24E-01

Best Fit Distribution: LogNormal

Quantity Plateau (Min Qty, Max Qty): 5.00 10.00

Average Repair Time (Min Qty, Max Qty): 8.47E-01 2.54E-01

CV or beta (Min Qty, Max Qty): 0.75 0.75

Quantity Unit: Each (1000 ft pipe)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No): NO

Casualty-affected Planar Area (sf) per Normative Unit: Not Applicable

Serious Injury (Median, Dispersion): 0% 0.00

Loss of Life (Median, Dispersion): 0% 0.00

Post-event Tagging Flag: NO

Unsafe Placard Trigger (Median, Dispersion): 0% 0.00

Comments: Consequence is for piping only. Enter floor wetting consequence seperately. Cost includes allowance for MEP relocation to perform work.

Date Created: None

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: 2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

D2051.011a
Chilled Water Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC A or B, PIPING FRAGILITY
Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Line 740

Construction Quality:	Normal				
Seismic Installation Conditions:	SDC A or B (no seismic design)				
Fragility Unit of Measure:	LF 1000				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	2				
Damage State:	DS1	DS2			
Type of Damage State:	Sequential Sequential				
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Small Leakage at joints - 1 leak per 1000 feet of pipe. Large Leakage w/ major repair - 1 leak per 1000 feet of pipe.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	Yes	

Illustrations					
	none	none			
	1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.55	1.1			
Data dispersion, β_d :	0.4	0.40			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	By User	By User			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Replace failed vertical braces. One repair per 1000 LF.				

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	9.00E+01	2.90E+02	7.40E+02	1.50E+03	2.65E+03	4.35E+03									
Best fit mean:	2.79E+02			2.80E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	3.19E+02 2.61E+02			2.92E+03 2.39E+03											
CV or beta (Min Qty, Max Qty)	0.76 0.76			0.41 0.41											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.53E-02	3.07E-01	7.84E-01	1.59E-01	2.81E-01	4.61E-01									
Best fit mean:	3.07E-01			2.81E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Time (Min Qty, Max Qty)	3.38E-01 2.76E-01			5.61E-01 1.40E-01											
CV or beta (Min Qty, Max Qty)	0.80 0.80			0.48 0.48											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments: Consequence is for piping only. Enter floor wetting consequence seperately. Cost includes allowance for MEP relocation to perform work.
Date Created: None
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2016-10-26 - Corrected consequence descriptions.
Root Cost Multiplier: 1

Root Cost Multiplier: 1

Line 742

Chilled Water Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC C, PIPING FRAGILITY
Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

DS1	DS2			
Sequential	Sequential			
Seq(DS1,DS2)				
Small Leakage at joints - 1 leak per 1000 feet of pipe.		Large Leakage w/ major repair - 1 leak per 1000 feet of pipe.		

none	none			
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Damage State Probability	1.00	1.00
Fracture Parameters		
Median Demand, θ :	0.55	1.1
Data dispersion, β_d :	0.4	0.40
Uncertainty, β_u :	Not Specified	Not Specified
Total Dispersion, β:	By User	By User
Correlation (Yes / No)	NO	
Directionality (Yes / No)	NO	
Quality Ratings		
Data Quality	Not Rated	
Data Relevance	Not Rated	
Documentation Quality	Not Rated	
Rationality	Not Rated	
Consequence Functions		
Repair Description	Retighten flange bolts at leaking joints.	Replace 20 foot sections of pipe where

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	9.00E+01	2.90E+02	7.40E+02	1.50E+03	2.65E+03	4.35E+03									
Best fit mean:	2.79E+02			2.60E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	3.19E+02 2.61E+02			2.92E+03 2.39E+03											
CV or beta (Min Qty, Max Qty)	0.76 0.76			0.41 0.41											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.53E-02	3.07E-01	7.84E-01	1.59E-01	2.81E-01	4.61E-01									
Best fit mean:	3.07E-01			2.81E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Time (Min Qty, Max Qty)	3.38E-01 2.76E-01			5.61E-01 1.40E-01											
CV or beta (Min Qty, Max Qty)	0.80 0.80			0.48 0.48											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
LifeSafety Hazard: Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

[illegible]

Line 743

Chilled Water Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC C, BRACING FRAGILITY
Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

<p>Descriptions</p>	<p>Isolated support failure w/o leakage - 0.5 supports fail per 1000 feet of pipe (assuming supports every 20 feet).</p>	<p>Multiple supports failure and 60 feet of pipe fail per 1000 feet of pipe (assuming supports every 20 feet).</p>
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2020	2020			

none
1.00

Repair Description

none	none
1.00	1.00

Replace failed lateral braces.
repair per 1000 LE

lateral braces.

none
1.00

Replace failed vertical braces.
repair per 1000 LE

NO

Revisions:

P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
1.80E+02	3.80E+02	8.30E+02	3.60E+03	3.80E+03	4.75E+03									

1.80E+02	3.80E+02	6.30E+02	3.80E+03	3.80E+03	4.25E+03
3.83E+02			3.87E+03		
LogNormal			LogNormal		

LogNormal	LogNormal		
5.00	10.00	5.00	10.00

4.18E+02	3.42E+02	4.18E+03	3.42E+03			
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[illegible]

Each (1000 ft pipe)	Each (1000 ft pipe)			
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P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
1.015.01	4.025.01	8.795.01	3.815.01	4.025.01	4.505.01									

[illegible]

LogNormal		LogNormal			
5.00	10.00	5.00	10.00		

4.43E-01	3.62E-01	8.05E-01	2.01E-01		
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0.65	0.65	0.26	0.26			
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Each (1000 ft pipe)	Each (1000 ft pipe)			
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NO	NO			
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Not Applicable	Not Applicable			
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	Not Applicable	Not Applicable		
	0%	0.00	0%	0.00

0%	0.00	0%	0.00		
20%	0.20	20%	0.20		

[illegible]

0%	0.00	0%	0.00			
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Consequence is for piping only. Enter floor wetting consequence seperately. Cost includes allowance for MEP relocation to perform work.

None	Root Cost Multiplier:	1
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By User
By User

Not Given
2016-10-26 - Corrected consequence descriptions.

2019-10-20 - Scheduled consequences completed.

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D2051.013b
Chilled Water Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC D, E, or F, BRACING FRAGILITY
Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Line 745

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

SDC D, E, F (high seismic design)

LF 1000

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Isolated support failure w/o leakage -
0.5 supports fail per 1000 feet of pipe
(assuming supports every 20 feet).

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO

Yes

Illustrations					
	none				

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.00

2.25

0.4

Not Specified
By User

NO

NO

Not Rated

Not Rated

Not Rated

Not Rated

Replace failed lateral braces. One
repair per 1000 LF.

Replace failed vertical braces. One
repair per 1000 LF.

Long Lead Time (Yes / No) NO

Repair Costs:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Cost by Damage State:	1.80E+02	3.80E+02	8.30E+02												
Best fit mean:	3.83E+02														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00														
Average Repair Cost (Min Qty, Max Qty)	4.18E+02 3.42E+02														
CV or beta (Min Qty, Max Qty)	0.60 0.60														
Quantity Unit:	Each (1000 ft pipe)														
Repair Time:	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀	P₁₀	P₅₀	P₉₀
Repair Time by Damage State:	1.91E-01	4.02E-01	8.79E-01												
Best fit mean:	4.02E-01														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00														
Average Repair Time (Min Qty, Max Qty)	4.43E-01 3.62E-01														
CV or beta (Min Qty, Max Qty)	0.65 0.65														
Quantity Unit:	Each (1000 ft pipe)														
LifeSafety Hazard:	NO														
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0% 0.00														
Loss of Life (Median, Dispersion)	0% 0.00														
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00														
Comments:	Consequence is for piping only. Enter floor wetting consequence seperately. Cost includes allowance for MEP relocation to perform work.														
Date Created:	None														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	2016-10-26 - Corrected consequence descriptions.														

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D2051.014a

Chilled Water Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC D, E, or F (OSHPD or sim), PIPING FRAGILITY

Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Special Regulations (e.g. OSHPD) for Piping Installations

SDC D, E, F (high seismic design)

LF 1000

Peak Floor Acceleration

2

DS1

Sequential

Seq(DS1,DS2)

Small Leakage at joints - 1 leak per 1000 feet of pipe.

Large Leakage w/ major repair - 1 leak per 1000 feet of pipe.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO

Yes

Illustrations

Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

0.55

0.4

Not Specified

By User

NO

NO

Not Rated

Not Rated

Not Rated

Not Rated

Retighten leaking joints, one per 1000 LF.

Replace 20 ft section of pipe at leaking joints, one per 1000 LF.

1.1

0.40

Not Specified

By User

NO

NO

Not Rated

Not Rated

Not Rated

Not Rated

Replace 20 ft section of pipe at leaking joints, one per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

9.00E+01

2.90E+02

7.40E+02

1.50E+03

2.65E+03

4.35E+03

2.79E+02

LogNormal

5.00

10.00

3.19E+02

2.61E+02

0.76

0.76

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

9.53E-02

3.07E-01

7.84E-01

1.59E+00

2.81E+00

4.61E+00

3.07E-01

LogNormal

5.00

10.00

3.38E-01

2.76E-01

0.80

0.80

Each (1000 ft pipe)

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

NO

NO

0%

0.00

Consequence is for piping only. Enter floor wetting consequence seperately. Cost includes allowance for MEP relocation to perform work.

None

By User

By User

Not Given

2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier:

1

[illegible]

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

D2051.021a

Chilled Water Piping - Large Diameter Welded Steel - (greater than 2.5 inches in diameter), SDC A or B, PIPING FRAGILITY
Costing based upon 1000 ft segments of pipe, pipe greater than 2.5 inches in diameter

Line 748

Construction Quality: Normal

Seismic Installation Conditions: SDC A or B (no seismic design)

Fragility Unit of Measure: LF 1000

Demand Parameter (unit): Peak Floor Acceleration g

Number of Damage States: 2

Damage State: DS1DS2

Type of Damage State: SequentialSequential

DS Hierarchy: Seq(DS1,DS2)

Descriptions: Minor leakage at flange connections - Pipe Break - 1 break per 1000 feet of
1 leak per 1000 feet of pipe. Retighten pipe.
flange at leaking joint.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

none

Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

1.5

2.6

Data dispersion, β_d :

0.4

0.40

Uncertainty, β_u :

Not Specified

Not Specified

Total Dispersion, β :

By User

By User

Correlation (Yes / No)

NO

Directionality (Yes / No)

NO

Quality Ratings

Data Quality

Not Rated

Data Relevance

Not Rated

Documentation Quality

Not Rated

Rationality

Not Rated

Consequence Functions

Repair Description

Retighten leaking joints, one per 1000 LF.

Replace 20 ft section of pipe at leaking joints, one per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

1.50E+02

3.50E+02

8.00E+02

1.80E+03

3.35E+03

5.35E+03

Best fit mean:

3.48E+02

3.21E+03

Best Fit Distribution:

LogNormal

LogNormal

Quantity Plateau (Min Qty, Max Qty)

5.00

10.00

5.00

10.00

Average Repair Cost (Min Qty, Max Qty)

7.00E+02

2.10E+02

6.70E+03

2.01E+03

CV or beta (Min Qty, Max Qty)

0.65

0.65

0.40

0.40

Quantity Unit:

Each (1000 ft pipe)

Each (1000 ft pipe)

Repair Time:

Repair Time by Damage State:

1.59E-01

3.71E-01

8.47E-01

1.91E+00

3.55E+00

5.66E+00

Best fit mean:

3.71E-01

3.55E+00

Best Fit Distribution:

LogNormal

LogNormal

Quantity Plateau (Min Qty, Max Qty)

5.00

10.00

5.00

10.00

Average Repair Time (Min Qty, Max Qty)

7.41E-01

2.22E-01

7.09E+00

2.13E+00

CV or beta (Min Qty, Max Qty)

0.70

0.70

0.47

0.47

Quantity Unit:

Each (1000 ft pipe)

Each (1000 ft pipe)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

NO

NO

Casualty-affected Planar Area (sf) per Normative Unit:

Not Applicable

Not Applicable

Serious Injury (Median, Dispersion)

0%

0.00

0%

0.00

Loss of Life (Median, Dispersion)

0%

0.00

0%

0.00

Post-event Tagging Flag:

NO

NO

Unsafe Placard Trigger (Median, Dispersion)

0%

0.00

0%

0.00

Comments:

Consequence is for piping only. Enter floor wetting consequence seperately. Cost includes allowance for MEP relocation to perform work.

Date Created:

None

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D2051.021b

Chilled Water Piping - Large Diameter Welded Steel - (greater than 2.5 inches in diameter), SDC A or B, BRACING FRAGILITY

Costing based upon 1000 ft segments of pipe, pipe greater than 2.5 inches in diameter

Line 749

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Construction Quality:

Normal

Seismic Installation Conditions:

SDC A or B (no seismic design)

Fragility Unit of Measure:

LF 1000

Demand Parameter (unit):

Peak Floor Acceleration

g

Number of Damage States:

1

Damage State:

DS1

Type of Damage State:

Sequential

DS Hierarchy

Seq(DS1)

Descriptions

Vertical Brace Failure - 1 failure per 1000 feet of pipe

Illustrations

none

1.00

2.25

0.4

Not Specified By User

NO

NO

Not Rated

Not Rated

Not Rated

Not Rated

Replace failed supports, one per 1000 LF.

Damage State Probability:

1.00

Fragility Parameters

Median Demand, θ :

2.25

Data dispersion, β_d :

0.4

Uncertainty, β_u :

Not Specified By User

Total Dispersion, β :

NO

Correlation (Yes / No)

NO

Directionality (Yes / No)

NO

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

Replace failed supports, one per 1000 LF.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Each (1000 ft pipe)

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Each (1000 ft pipe)

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

Consequence is for piping only. Enter floor wetting consequence seperately. Cost includes allowance for MEP relocation to perform work.

None

By User

By User

Not Given

2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

D2051.022a

Chilled Water Piping - Large Diameter Welded Steel - (greater than 2.5 inches in diameter), SDC C, PIPING FRAGILITY
Costing based upon 1000 ft segments of pipe, pipe greater than 2.5 inches in diameter

Line 750

Construction Quality:	Normal					<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? Yes</div>
Seismic Installation Conditions:	SDC C (low seismic design)					
Fragility Unit of Measure:	LF 1000					
Demand Parameter (unit):	Peak Floor Accelerationg					
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Minor leakage at flange connections - 1 leak per 1000 feet of pipe. Pipe Break - 1 break per 1000 feet of pipe.					

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations					
	none	none			
Damage State Probability:	1.00	1.00			

Fragility Parameters					
Median Demand, θ :	1.5	2.6			
Data dispersion, β_d :	0.4	0.40			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β_t :	By User	By User			

Correlation (Yes / No) NO

Directionality (Yes / No) NO

Quality Ratings

Data Quality Not Rated

Data Relevance Not Rated

Documentation Quality Not Rated

Rationality Not Rated

Consequence Functions

Repair Description Retighten leaking joints, one per 1000 LF. Replace 20 ft section of pipe at leaking joints, one per 1000 LF.

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.50E+02	3.50E+02	8.00E+02	1.80E+03	3.35E+03	5.35E+03									
Best fit mean:	3.48E+02			3.21E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	7.00E+02 2.10E+02			6.70E+03 2.01E+03											
CV or beta (Min Qty, Max Qty)	0.65 0.65			0.40 0.40											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.59E-01	3.71E-01	8.47E-01	1.91E+00	3.55E+00	5.66E+00									
Best fit mean:	3.71E-01			3.55E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Time (Min Qty, Max Qty)	7.41E-01 2.22E-01			7.09E+00 2.13E+00											
CV or beta (Min Qty, Max Qty)	0.70 0.70			0.47 0.47											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments: Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.
Date Created: None
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2016-10-26 - Corrected consequence descriptions.
Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

D2051.023a
Chilled Water Piping - Large Diameter Welded Steel - (greater than 2.5 inches in diameter), SDC D, E, or F, PIPING FRAGILITY
Costing based upon 1000 ft segments of pipe, pipe greater than 2.5 inches in diameter

Line 751

Construction Quality:	Normal				<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? Yes</div>
Seismic Installation Conditions:	SDC D, E, F (high seismic design)				
Fragility Unit of Measure:	LF 1000				
Demand Parameter (unit):	Peak Floor Accelerationg				
Number of Damage States:	2				
Damage State:	DS1		DS2		
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Minor leakage at flange connections - Pipe Break - 1 break per 1000 feet of pipe. 1 leak per 1000 feet of pipe.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations

none	none			
1.00	1.00			

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	2.25	4.1		
Data dispersion, β_d :	0.4	0.40		
Uncertainty, β_u :	Not Specified	Not Specified		
Total Dispersion, β :	By User	By User		
Correlation (Yes / No)	NO			
Directionality (Yes / No)	NO			
Quality Ratings				
Data Quality	Not Rated			
Data Relevance	Not Rated			
Documentation Quality	Not Rated			
Rationality	Not Rated			
Consequence Functions				
Repair Description	Retighten leaking joints, one per 1000 LF. Replace 20 ft section of pipe at leaking joints, one per 1000 LF.			

Long Lead Time (Yes / No)

NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.50E+02	3.50E+02	8.00E+02	1.80E+03	3.35E+03	5.35E+03									
Best fit mean:	3.48E+02			3.21E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00	5.00		10.00									
Average Repair Cost (Min Qty, Max Qty)	7.00E+02		2.10E+02	6.70E+03		2.01E+03									
CV or beta (Min Qty, Max Qty)	0.65		0.65	0.40		0.40									
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.59E-01	3.71E-01	8.47E-01	1.91E+00	3.55E+00	5.66E+00									
Best fit mean:	3.71E-01			3.55E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00		10.00	5.00		10.00									
Average Repair Time (Min Qty, Max Qty)	7.41E-01		2.22E-01	7.09E+00		2.13E+00									
CV or beta (Min Qty, Max Qty)	0.70		0.70	0.47		0.47									
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00									
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00									
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	0%		0.00									

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D2051.024b

Chilled Water Piping - Large Diameter Welded Steel - (greater than 2.5 inches in diameter), SDC D, E, or F (OSHDP or sim), BRACING FRAGILITY

Costing based upon 1000 ft segments of pipe, pipe greater than 2.5 inches in diameter

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Special Regulation (e.g. OSHPD) for Piping Installations

SDC D, E, F (high seismic design)

LF 1000

Peak Floor Acceleration

g

2

DS1

DS2

Sequential

Seq(DS1,DS2)

Lateral Brace Failure - 1 failure per 1000 foot of pipe.

Vertical Brace Failure - 1 failure per 1000 feet of pipe.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO

Yes

Illustrations

none

none

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.00

1.00

1.5

0.4

Not Specified

By User

2.25

0.40

Not Specified

By User

NO

NO

Not Rated

Not Rated

Not Rated

Not Rated

Replace failed supports, one per 1000 LF.

Replace failed supports, one per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.50E+02

3.50E+02

8.00E+02

1.50E+02

3.50E+02

8.00E+02

3.48E+02

LogNormal

5.00

10.00

7.00E+02

0.65

2.10E+02

0.65

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.59E-01

3.71E-01

8.47E-01

1.59E-01

3.71E-01

8.47E-01

3.71E-01

LogNormal

5.00

10.00

7.41E-01

0.70

2.22E-01

0.70

Each (1000 ft pipe)

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

NO

NO

0%

0.00

Consequence is for piping only. Enter floor wetting consequence seperately. Cost includes allowance for MEP relocation to perform work.

None

By User

By User

Not Given

2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification D2061.011a
NISTIR Name Steam Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC A or B, PIPING FRAGILITY
Description Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Line 755

Construction Quality:	Normal				
Seismic Installation Conditions:	SDC A or B (no seismic design)				
Fragility Unit of Measure:	LF 1000				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	2				
Damage State:	DS1	DS2			
Type of Damage State:	Sequential				
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Small Leakage at joints - 1 leak per 1000 feet of pipe. Large Leakage w/ major repair - 1 leak per 1000 feet of pipe. Replace one 20 ft section per 1000 LF pipe.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	Yes	

Illustrations					
	none	none			
	1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	0.55	1.1			
Data dispersion, β_d :	0.4	0.40			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β_t :	By User	By User			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Retighten leaking joints, one per 1000 LF. Replace 20 ft section of pipe at leaking joints, one per 1000 LF.				

Long Lead Time (Yes / No) NO NO

Repair Costs:		P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:		9.00E+01	2.90E+02	7.40E+02	1.50E+03	2.65E+03	4.35E+03									
Best fit mean:		2.79E+02			2.80E+03											
Best Fit Distribution:		LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)		5.00		10.00	5.00		10.00									
Average Repair Cost (Min Qty, Max Qty)		3.19E+02		2.61E+02	2.92E+03		2.39E+03									
CV or beta (Min Qty, Max Qty)		0.76		0.76	0.41		0.41									
Quantity Unit:		Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:		P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:		9.53E-02	3.07E-01	7.84E-01	1.59E-01	2.81E-01	4.61E-01									
Best fit mean:		3.07E-01			2.81E-01											
Best Fit Distribution:		LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)		5.00		10.00	5.00		10.00									
Average Repair Time (Min Qty, Max Qty)		3.38E-01		2.76E-01	5.61E-01		1.40E-01									
CV or beta (Min Qty, Max Qty)		0.80		0.80	0.48		0.48									
Quantity Unit:		Each (1000 ft pipe)			Each (1000 ft pipe)											
LifeSafety Hazard:																
Potential non-collapse casualties? (Yes / No)		NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:		Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)		0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)		0%	0.00		0%	0.00										
Post-event Tagging Flag:		NO			NO											
Unsafe Placard Trigger (Median, Dispersion)		0%	0.00		0%	0.00										
Comments:		Consequence is for piping only. Enter floor wetting consequence seperately. Cost includes allowance for MEP relocation to perform work.														
Date Created:		Not Given														
Approved (YES / NO)?		By User														
Official (YES / NO) ?		By User														
Author:		Not Given														
Revisions:		2016-10-26 - Corrected consequence descriptions.														
		Root Cost Multiplier: 1														

Root Cost Multiplier: 1

Line 758

Steam Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC C, BRACING FRAGILITY
Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

DS1	DS2		
Sequential	Sequential		
Seq(DS1,DS2)			
Isolated support failure w/o leakage - 1 supports fail per 1000 feet of pipe (assuming supports every 20 feet).	Multiple supports failure and 60 feet of pipe fail per 1000 feet of pipe (assuming supports every 20 feet).		

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Damage State Probability:	1.00	1.00
Fragility Parameters		
Median Demand, θ_i :	1.2	2.4
Data dispersion, β_{di} :	0.5	0.50
Uncertainty, β_{ui} :	Not Specified	Not Specified
Total Dispersion, β_i:	By User	By User
Correlation (Yes / No)	NO	
Directionality (Yes / No)	NO	
Quality Ratings		
Data Quality	Not Rated	
Data Relevance	Not Rated	
Documentation Quality	Not Rated	
Rationality	Not Rated	
Consequence Functions		
Repair Description	Replace failed supports, one per 1000	Replace 60 ft pipe and supports per

Long Lead Time (Yes / No)	NO	NO
---------------------------	----	----

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.80E+02	3.80E+02	8.30E+02	3.60E+03	3.80E+03	4.25E+03									
Best fit mean:	3.83E+02			3.87E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	4.18E+02 3.42E+02			4.18E+03 3.42E+03											
CV or beta (Min Qty, Max Qty)	0.60 0.60			0.07 0.07											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.91E-01	4.02E-01	8.79E-01	3.81E-01	4.02E-01	4.50E-01									
Best fit mean:	4.02E-01			4.02E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Time (Min Qty, Max Qty)	4.43E-01 3.62E-01			8.05E-01 2.01E-01											
CV or beta (Min Qty, Max Qty)	0.65 0.65			0.26 0.26											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
LifeSafety Hazard: Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

[illegible]

FEMA P-58 Fragility Specification

NISTIR Classification D2061.013a
NISTIR Name Steam Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC D, E, or F, PIPING FRAGILITY
Description Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Line 759

Construction Quality:	Normal				
Seismic Installation Conditions:	SDC D, E, F (high seismic design)				
Fragility Unit of Measure:	LF 1000				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	2				
Damage State:	DS1	DS2			
Type of Damage State:	Sequential Sequential				
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Small Leakage at joints - 1 leak per 1000 feet of pipe. Large Leakage w/ major repair - 1 leak per 1000 feet of pipe. Replace one 20 ft section per 1000 LF pipe.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	NO	
Demand Location (floor above?)	Yes	

Illustrations					
	none	none			
Damage State Probability:	1.00	1.00			

Fragility Parameters					
Median Demand, θ :	0.55	1.1			
Data dispersion, β_d :	0.4	0.40			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	By User	By User			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Retighten flange bolts at leaking joints, 1 joint per 1000 LF. Replace 20 foot sections of pipe where breaks occur, one per 1000 LF.				

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	9.00E+01	2.90E+02	7.40E+02	1.50E+03	2.65E+03	4.35E+03									
Best fit mean:	2.79E+02			2.80E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	3.19E+02 2.61E+02			2.92E+03 2.39E+03											
CV or beta (Min Qty, Max Qty)	0.76 0.76			0.41 0.41											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.53E-02	3.07E-01	7.84E-01	1.59E+00	2.81E+00	4.61E+00									
Best fit mean:	3.07E-01			2.81E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Time (Min Qty, Max Qty)	3.38E-01 2.76E-01			3.09E+00 2.53E+00											
CV or beta (Min Qty, Max Qty)	0.80 0.80			0.48 0.48											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments: Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2016-10-26 - Corrected consequence descriptions.
Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification D2061.013b
NISTIR Name Steam Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC D, E, or F, BRACING FRAGILITY
Description Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

Line 760

Construction Quality: Normal

Seismic Installation Conditions: SDC D, E, F (high seismic design)

Fragility Unit of Measure: LF 1000

Demand Parameter (unit): Peak Floor Acceleration g

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1)

Descriptions: Isolated support failure w/o leakage - 1 supports fail per 1000 feet of pipe (assuming supports every 20 feet).

Quantity Rounding: NO

Round Qty?: NO

Allow sum by floor or building?: NO

Demand Location (floor above?): Yes

Illustrations					
	none				

Damage State Probability: 1.00

Fragility Parameters

Median Demand, θ : 2.25

Data dispersion, β_d : 0.4

Uncertainty, β_u : Not Specified

Total Dispersion, β : By User

Correlation (Yes / No): NO

Directionality (Yes / No): NO

Quality Ratings

Data Quality: Not Rated

Data Relevance: Not Rated

Documentation Quality: Not Rated

Rationality: Not Rated

Consequence Functions

Repair Description: Replace failed supports, one per 1000 LF.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.80E+02	3.80E+02	8.30E+02												
Best fit mean:	3.83E+02														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	5.00	10.00													
Average Repair Cost (Min Qty, Max Qty)	4.18E+02	3.42E+02													
CV or beta (Min Qty, Max Qty)	0.60	0.60													
Quantity Unit:	Each (1000 ft pipe)														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.91E-01	4.02E-01	8.79E-01												
Best fit mean:	4.02E-01														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	5.00	10.00													
Average Repair Time (Min Qty, Max Qty)	4.43E-01	3.62E-01													
CV or beta (Min Qty, Max Qty)	0.65	0.65													
Quantity Unit:	Each (1000 ft pipe)														
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	Consequence is for piping only. Enter floor wetting consequence seperately. Cost includes allowance for MEP relocation to perform work.														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	2016-10-26 - Corrected consequence descriptions.														

Root Cost Multiplier: 1

Line 761

Steam Piping - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC D, E, or F (OSHPD or sim), PIPING FRAGILITY
Costing based upon 1000 ft segments of pipe, pipe 2.5 inches in diameter or less

per 1000 feet of pipe. Replace one 20 ft section per 1000 LF pipe.

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

none	none			
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1.00	1.00			
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Repair Description

Retighten flange bolts at leaking joints, 1 joint per 1000 LF	Replace 20 foot sections of pipe where breaks occur, one per 1000 LF
---	--

NO

Author:

Not Given

Not Given Root Cost Multiplier: 1

Not Given

2016-10-26 - Corrected consequence descriptions.

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.		Root Cost Multiplier:	1
Not Given			
By User			
Not Given			
2016-10-26 - Corrected consequence descriptions.			

Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.	
Not Given	Root Cost Multiplier: 1
By User	
By User	
Not Given	
2016-10-26 - Corrected consequence descriptions.	

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D2061.023a

Steam Piping - Large Diameter Welded Steel - (greater than 2.5 inches in diameter), SDC D, E, or F, PIPING FRAGILITY

Costing based upon 1000 ft segments of pipe, pipe greater than 2.5 inches in diameter

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

SDC D, E, F (high seismic design)

LF 1000

Peak Floor Acceleration

2

DS1

Sequential

Seq(DS1,DS2)

Minor leakage at flange connections - 1 leak per 1000 feet of pipe.

Pipe Break - 1 break per 1000 feet of pipe

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO

Yes

DS2

Sequential

Seq(DS1,DS2)

Pipe Break - 1 break per 1000 feet of pipe

Illustrations

Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

2.25

Not Specified

Not Specified

0.4

NO

NO

Marginal

Superior

Marginal

Marginal

Retighten flange bolts at leaking joints, 1 joint per 1000 LF.

Replace 20 foot sections of pipe where breaks occur, one per 1000 LF.

4.1

Not Specified

Not Specified

0.4

NO

NO

Marginal

Superior

Marginal

Marginal

Retighten flange bolts at leaking joints, 1 joint per 1000 LF.

Replace 20 foot sections of pipe where breaks occur, one per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.50E+02

3.50E+02

8.00E+02

1.80E+03

3.35E+03

5.35E+03

3.48E+02

LogNormal

5.00

10.00

7.00E+02

2.10E+02

0.65

0.65

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.59E-01

3.71E-01

8.47E-01

1.91E+00

3.55E+00

5.66E+00

3.71E-01

LogNormal

5.00

10.00

7.41E-01

2.22E-01

0.70

0.70

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.91E+00

3.55E+00

5.66E+00

3.55E+00

LogNormal

5.00

10.00

7.09E+00

2.13E+00

0.47

0.47

Each (1000 ft pipe)

NO

YES

Not Applicable

10 SF

0%

0.00

5%

0.50

0%

0.00

0%

0.00

0%

0.00

Consequence is for piping only. Enter floor wetting consequence seperately. Cost includes allowance for MEP relocation to perform work.

Not Given

By User

By User

Not Given

2016-10-26 - Corrected consequence descriptions.

Root Cost Multiplier:

1

Line 421

Steam Piping - Large Diameter Welded Steel - (greater than 2.5 inches in diameter), SDC D, E, or F (OSHPD or sim), PIPING FRAGILITY
Costing based upon 1000 ft segments of pipe, pipe greater than 2.5 inches in diameter

1 leak per 1000 feet of pipe. pipe

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations

none	none			
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Repair Description

Retighten f

Retighten flange bolts at leaking joints, 1 joint per 1000 LF.	Replace 20 foot sections of pipe where breaks occur, one per 1000 LF.
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Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.50E+02	3.50E+02	8.00E+02	1.80E+03	3.35E+03	5.35E+03									
Best fit mean:	3.48E+02			3.21E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Cost (Min Qty, Max Qty)	7.00E+02 2.10E+02			6.70E+03 2.01E+03											
CV or beta (Min Qty, Max Qty)	0.65 0.65			0.40 0.40											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.59E-01	3.71E-01	8.47E-01	1.91E+00	3.55E+00	5.66E+00									
Best fit mean:	3.71E-01			3.55E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	5.00 10.00			5.00 10.00											
Average Repair Time (Min Qty, Max Qty)	7.41E-01 2.22E-01			7.09E+00 2.13E+00											
CV or beta (Min Qty, Max Qty)	0.70 0.70			0.47 0.47											
Quantity Unit:	Each (1000 ft pipe)			Each (1000 ft pipe)											
LifeSafety Hazard:	NO			YES											
Potential non-collapse casualties? (Yes / No)	NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			10 SF											
Serious Injury (Median, Dispersion)	0% 0.00			5% 0.50											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments:	Consequence is for piping only. Enter floor wetting consequence separately. Cost includes allowance for MEP relocation to perform work.				
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Root Cost Multiplier: 1

Official (YES / NO) ? By User

Author: Not Given

Revisions: 2016-10-2

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D2061.024b

Steam Piping - Large Diameter Welded Steel - (greater than 2.5 inches in diameter), SDC D, E, or F (OSHDP or sim), BRACING FRAGILITY

Costing based upon 1000 ft segments of pipe, pipe greater than 2.5 inches in diameter

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Special Regulation (e.g. OSHPD) for Piping Installations

SDC D, E, F (high seismic design)

LF 1000

Peak Floor Acceleration

2

DS1

Sequential

Seq(DS1,DS2)

Lateral Brace Failure - 1 failure per 1000 feet of pipe.

DS2

Sequential

Vertical Brace Failure - 1 failure per 1000 feet of pipe

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO

Yes

Illustrations

none

none

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.00

1.5

Not Specified

Not Specified

0.4

NO

NO

Marginal

Superior

Marginal

Marginal

Replace failed supports, one per 1000 LF.

Replace failed supports, one per 1000 LF.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

1.50E+02

3.50E+02

8.00E+02

P₁₀

P₅₀

P₉₀

1.50E+02

3.50E+02

8.00E+02

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Each (1000 ft pipe)

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

1.59E-01

3.71E-01

8.47E-01

P₁₀

P₅₀

P₉₀

1.59E-01

3.71E-01

8.47E-01

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

Each (1000 ft pipe)

Each (1000 ft pipe)

NO

Not Applicable

0%

0.00

NO

Not Applicable

0%

0.00

0%

0.00

0%

0.00

Consequence is for piping only. Enter floor wetting consequence seperately. Cost includes allowance for MEP relocation to perform work.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.011a

Chiller - Capacity: < 100 Ton - Unanchored equipment that is not vibration isolated - Equipment fragility only

Costing is per unit and is based upon 75 Ton.

Line 423

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Unanchored equipment that is not vibration isolated

TN 75

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.00

0.2

0.4

0.1

0.4

NO

NO

Average

Average

Superior

Superior

Repair chiller and attached piping.

Chiller removed, repaired offsite, and

reinstalled.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau

(Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau

(Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties?

(Yes / No)

Casualty-affected Planar Area (sf)

per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.91E+04

4.62E+04

6.08E+04

4.78E+04

LogNormal

1.00

5.00

5.08E+04

4.16E+04

0.18

0.18

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

8.05E+00

9.51E+00

1.25E+01

9.51E+00

LogNormal

1.00

5.00

1.43E+01

4.76E+00

0.31

0.31

Each

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

None

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.011b

Chiller - Capacity: 100 to <350 Ton - Unanchored equipment that is not vibration isolated - Equipment fragility only

Costing is per unit and is based upon 250 Ton.

Line 424

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Unanchored equipment that is not vibration isolated

TN 250

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

YES

BLDG

No

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.00

0.2

0.4

0.1

0.4

NO

NO

Average

Average

Superior

Superior

Repair chiller and attached piping.

Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

Repair Costs:

Repair Time:

LifeSafety Hazard:

Casualty-affected Planar Area (sf)

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

1.31E+05

1.53E+05

1.99E+05

1.58E+05

LogNormal

1.00

5.00

1.68E+05

0.17

1.38E+05

0.17

Each

P₁₀

P₅₀

P₉₀

2.02E+01

2.36E+01

3.08E+01

2.36E+01

LogNormal

1.00

5.00

3.94E+01

0.30

1.18E+01

0.30

Each

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

None

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.011c

Chiller - Capacity: 350 to <750 Ton - Unanchored equipment that is not vibration isolated - Equipment fragility only

Costing is per unit and is based upon 500 Ton.

Line 425

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Unanchored equipment that is not vibration isolated

TN 500

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.00

0.2

0.4

0.1

0.4

NO

NO

Average

Average

Superior

Superior

Repair chiller and attached piping.

Chiller removed, repaired offsite, and

reinstalled.

Long Lead Time (Yes / No)

YES

Repair Costs:

Repair Time:

LifeSafety Hazard:

Casualty-affected Planar Area (sf)

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.17E+05

2.55E+05

3.33E+05

2.64E+05

LogNormal

1.00

5.00

2.81E+05

2.30E+05

0.17

0.17

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.24E+01

2.63E+01

3.42E+01

2.63E+01

LogNormal

1.00

5.00

5.25E+01

1.31E+01

0.30

0.30

Each

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

None

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.011d

Chiller - Capacity: 750 to <1000 Ton - Unanchored equipment that is not vibration isolated - Equipment fragility only

Line 426

Costing is per unit and is based upon 850 Ton.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Unanchored equipment that is not vibration isolated

TN 850

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.00

0.2

0.4

0.1

0.4

NO

NO

Average

Average

Superior

Superior

Repair chiller and attached piping.

Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

Repair Costs:

Repair Time:

LifeSafety Hazard:

Casualty-affected Planar Area (sf)

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.66E+05

4.31E+05

5.62E+05

4.45E+05

LogNormal

1.00

5.00

4.74E+05

3.88E+05

0.17

0.17

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.63E+01

3.11E+01

4.05E+01

3.11E+01

LogNormal

1.00

5.00

7.54E+01

1.55E+01

0.30

0.30

Each

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

None

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

D3031.012a

Chiller - Capacity: < 100 Ton - Vibration isolated equipment that is not snubbed or restrained - Anchorage fragility only
Costing is per unit and is based upon 75 Ton.

Line 427

Construction Quality:	Normal - Not designed for seismic loads			
Seismic Installation Conditions:	Vibration isolated equipment that is not snubbed or restrained			
Fragility Unit of Measure:	TN 75			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	2			
Damage State:	DS1	DS2		
Type of Damage State:	Mutually Exclusive		Mutually Exclusive	
DS Hierarchy	MutEx(DS1,DS2)			
Descriptions	Anchorage failure.		Anchorage failure & Equipment damaged beyond repair.	

Quantity Rounding	Round Qty?	YES
	Allow sum by floor or building?	BLDG
Demand Location (floor above?)		No

Illustrations					
	none	none			
Damage State Probability:	0.70	0.30			

Fragility Parameters					
Median Demand, θ :	By User	By User			
Data dispersion, β_d :	User to Calculate	User to Calculate			
Uncertainty, β_u :	User to Calculate	User to Calculate			
Total Dispersion, β :	By User	By User			

Correlation (Yes / No)

NO

Directionality (Yes / No)

NO

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

Average

Average

Superior

Superior

Repair anchorage and concrete pad and remount equipment. Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	5.00E+02	1.00E+03	1.70E+03	3.96E+04	4.72E+04	6.25E+04									
Best fit mean:	9.59E+02			4.88E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Cost (Min Qty, Max Qty)	2.00E+03 6.00E+02			9.44E+04 2.83E+04											
CV or beta (Min Qty, Max Qty)	0.45 0.45			0.18 0.18											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.15E-01	1.03E+00	1.75E+00	8.15E+00	9.72E+00	1.29E+01									
Best fit mean:	1.03E+00			9.72E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Time (Min Qty, Max Qty)	2.06E+00 6.18E-01			5.83E+01 4.86E+00											
CV or beta (Min Qty, Max Qty)	0.52 0.52			0.31 0.31											
Quantity Unit:	Each			Each											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments: User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Date Created: Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2016-10-25 - Repair method clarified.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.012b

Chiller - Capacity: < 100 Ton - Vibration isolated equipment that is not snubbed or restrained - Equipment fragility only

Costing is per unit and is based upon 75 Ton.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

TN 75

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

YES

BLDG

No

Illustrations

none

1.00

0.43

0.6

0.1

0.6

NO

NO

Average

Average

Superior

Superior

Repair chiller and attached piping.

Chiller removed, repaired offsite, and reinstalled.

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

NO

NO

Average

Average

Superior

Superior

Repair chiller and attached piping.

Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.91E+04

4.62E+04

6.08E+04

4.78E+04

LogNormal

1.00

5.00

5.08E+04

4.16E+04

0.18

0.18

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

8.05E+00

9.51E+00

1.25E+01

9.51E+00

LogNormal

1.00

5.00

1.43E+01

4.76E+00

0.31

0.31

Each

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

None

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

D3031.012d

Chiller - Capacity: 100 to <350 Ton - Vibration isolated equipment that is not snubbed or restrained - Anchorage fragility only
Costing is per unit and is based upon 250 Ton.

Line 430

Construction Quality: Normal - Not designed for seismic loads
Seismic Installation Conditions: Vibration isolated equipment that is not snubbed or restrained

Fragility Unit of Measure: TN 250
Demand Parameter (unit): Peak Floor Acceleration g

Number of Damage States: 2

Damage State:	DS1	DS2			
---------------	-----	-----	--	--	--

Type of Damage State: Mutually Exclusive Mutually Exclusive

DS Hierarchy: MutEx(DS1,DS2)

Descriptions: Anchorage failure. Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		BLDG
Demand Location (floor above?)	No	

Illustrations

none	none			
0.70	0.30			

Damage State Probability:

Fragility Parameters				
Median Demand, θ :	By User	By User		
Data dispersion, β_d :	User to Calculate	User to Calculate		
Uncertainty, β_u :	User to Calculate	User to Calculate		
Total Dispersion, β_t :	By User	By User		

Correlation (Yes / No) NO

Directionality (Yes / No) NO

Quality Ratings

Data Quality Average

Data Relevance Average

Documentation Quality Superior

Rationality Superior

Consequence Functions

Repair Description: Repair anchorage and concrete pad and remount equipment. Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	8.00E+02	1.50E+03	2.40E+03	1.31E+05	1.55E+05	2.02E+05									
Best fit mean:	1.57E+03			1.80E+05											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Cost (Min Qty, Max Qty)	3.00E+03 9.00E+02			3.09E+05 9.27E+04											
CV or beta (Min Qty, Max Qty)	0.40 0.40			0.17 0.17											
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.24E-01	1.54E+00	2.47E+00	2.03E+01	2.39E+01	3.11E+01									
Best fit mean:	1.54E+00			2.39E+01											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00											
Average Repair Time (Min Qty, Max Qty)	3.09E+00 9.26E-01			1.83E+02 1.19E+01											
CV or beta (Min Qty, Max Qty)	0.47 0.47			0.30 0.30											
Quantity Unit:	Each			Each											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments: User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: 2016-10-25 - Repair method clarified.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.012f

Chiller - Capacity: 100 to <350 Ton - Vibration isolated equipment that is not snubbed or restrained - Combined anchorage/isolator & equipment fragility

Costing is per unit and is based upon 250 Ton.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

TN 250

Peak Floor Acceleration

g

3

DS1

DS2

DS3

Mutually Exclusive

Mutually Exclusive

Mutually Exclusive

MutEx(DS1,DS2,DS3)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Damaged, Inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

Damage State Probability:

0.35

0.15

0.50

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

NO

NO

Average

Average

Superior

Superior

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Chiller removed, repaired offsite, and reinstalled.

Repair chiller and attached piping. Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

YES

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

8.00E+02

1.50E+03

2.40E+03

1.31E+05

1.55E+05

2.02E+05

1.31E+05

1.55E+05

2.02E+05

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

8.24E-01

1.54E+00

2.47E+00

2.03E+01

2.39E+01

3.11E+01

2.03E+01

2.39E+01

3.11E+01

Each

NO

NO

NO

Not Applicable

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

0%

0.00

NO

NO

NO

0%

0.00

0%

0.00

0%

0.00

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification
NISTIR Name
Description

D3031.012g
Chiller - Capacity: 350 to <750 Ton - Vibration isolated equipment that is not snubbed or restrained - Anchorage fragility only
Costing is per unit and is based upon 500 Ton.

Line 433

Construction Quality:	Normal - Not designed for seismic loads				
Seismic Installation Conditions:	Vibration isolated equipment that is not snubbed or restrained				
Fragility Unit of Measure:	TN 500				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	2				
Damage State:	DS1	DS2			
Type of Damage State:	Mutually Exclusive		Mutually Exclusive		
DS Hierarchy	MutEx(DS1,DS2)				
Descriptions	Anchorage failure.		Anchorage failure & Equipment damaged beyond repair.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		BLDG
Demand Location (floor above?)		No

Illustrations					
	none	none			
Damage State Probability:	0.70	0.30			

Fragility Parameters					
Median Demand, θ :	By User	By User			
Data dispersion, β_d :	User to Calculate	User to Calculate			
Uncertainty, β_u :	User to Calculate	User to Calculate			
Total Dispersion, β :	By User	By User			

Correlation (Yes / No)	NO
Directionality (Yes / No)	NO
Quality Ratings	
Data Quality	Average
Data Relevance	Average
Documentation Quality	Superior
Rationality	Superior
Consequence Functions	
Repair Description	Repair anchorage and concrete pad and remount equipment.
	Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No) YES YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.40E+03	2.20E+03	3.10E+03	2.19E+05	2.57E+05	3.36E+05									
Best fit mean:	2.23E+03			2.66E+05											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Cost (Min Qty, Max Qty)	4.40E+03		1.32E+03	5.15E+05		1.54E+05									
CV or beta (Min Qty, Max Qty)	0.30		0.30	0.17		0.17									
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.44E+00	2.26E+00	3.19E+00	2.25E+01	2.65E+01	3.46E+01									
Best fit mean:	2.26E+00			2.65E+01											
Best Fit Distribution:	Normal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Time (Min Qty, Max Qty)	4.53E+00		1.36E+00	2.91E+02		1.32E+01									
CV or beta (Min Qty, Max Qty)	0.39		0.39	0.30		0.30									
Quantity Unit:	Each			Each											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	2016-10-25 - Repair method clarified.														

Root Cost Multiplier: 1

Root Cost Multiplier: 1

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification
NISTIR Name
Description

D3031.012j
Chiller - Capacity: 750 to <1000 Ton - Vibration isolated equipment that is not snubbed or restrained - Anchorage fragility only
Costing is per unit and is based upon 850 Ton.

Line 436

Construction Quality:	Normal - Not designed for seismic loads				
Seismic Installation Conditions:	Vibration isolated equipment that is not snubbed or restrained				
Fragility Unit of Measure:	TN 850				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	2				
Damage State:	DS1	DS2			
Type of Damage State:	Mutually Exclusive		Mutually Exclusive		
DS Hierarchy	MutEx(DS1,DS2)				
Descriptions	Anchorage failure.		Anchorage failure & Equipment damaged beyond repair.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		BLDG
Demand Location (floor above?)		No

Illustrations					
	none	none			
Damage State Probability:	0.70	0.30			

Fragility Parameters					
Median Demand, θ :	By User	By User			
Data dispersion, β_d :	User to Calculate	User to Calculate			
Uncertainty, β_u :	User to Calculate	User to Calculate			
Total Dispersion, β_t :	By User	By User			

Correlation (Yes / No)	NO
Directionality (Yes / No)	NO
Quality Ratings	
Data Quality	Average
Data Relevance	Average
Documentation Quality	Superior
Rationality	Superior
Consequence Functions	
Repair Description	Repair anchorage and concrete pad and remount equipment.
	Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No) YES YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.60E+03	2.40E+03	3.40E+03	3.67E+05	4.33E+05	5.65E+05									
Best fit mean:	2.36E+03			4.48E+05											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Cost (Min Qty, Max Qty)	4.80E+03		1.44E+03	8.67E+05		2.60E+05									
CV or beta (Min Qty, Max Qty)	0.29		0.29	0.17		0.17									
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.65E+00	2.47E+00	3.50E+00	2.65E+01	3.12E+01	4.07E+01									
Best fit mean:	2.47E+00			3.12E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Time (Min Qty, Max Qty)	4.94E+00		1.48E+00	4.77E+02		1.56E+01									
CV or beta (Min Qty, Max Qty)	0.38		0.38	0.30		0.30									
Quantity Unit:	Each			Each											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00									
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00									
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	0%		0.00									

Root Cost Multiplier: 1

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.0121
Chiller - Capacity: 750 to <1000 Ton - Vibration isolated equipment that is not snubbed or restrained - Combined anchorage/isolator & equipment fragility
Costing is per unit and is based upon 850 Ton.

Line 438

Construction Quality:	Normal - Not designed for seismic loads			
Seismic Installation Conditions:	Vibration isolated equipment that is not snubbed or restrained			
Fragility Unit of Measure:	TN 850			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive	
DS Hierarchy	MutEx(DS1,DS2,DS3)			
Descriptions	Anchorage failure.	Anchorage failure & Equipment damaged beyond repair.	Damaged, Inoperative but anchorage is OK.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		BLDG
Demand Location (floor above?)		No

Illustrations					
	none	none	none		
Damage State Probability:	0.35	0.15	0.50		

Fragility Parameters					
Median Demand, θ :	By User	By User	By User		
Data dispersion, β_d :	User to Calculate	User to Calculate	User to Calculate		
Uncertainty, β_u :	User to Calculate	User to Calculate	User to Calculate		
Total Dispersion, β :	By User	By User	By User		

Correlation (Yes / No)
Directionality (Yes / No)
Quality Ratings
Data Quality
Data Relevance
Documentation Quality
Rationality
Consequence Functions
Repair Description

NO
NO
Average
Average
Superior
Superior
Repair anchorage and concrete pad and remount equipment.
Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Chiller removed, repaired offsite, and reinstalled.
Repair chiller and attached piping. Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)	YES	YES	YES		
Repair Costs:	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀
Repair Cost by Damage State:	1.60E+03 2.40E+03 3.40E+03	3.67E+05 4.33E+05 5.65E+05	3.67E+05 4.33E+05 5.65E+05		
Best fit mean:	2.36E+03	4.48E+05	4.48E+05		
Best Fit Distribution:	LogNormal	LogNormal	LogNormal		
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00	1.00 5.00	1.00 5.00		
Average Repair Cost (Min Qty, Max Qty)	2.64E+03 2.16E+03	4.77E+05 3.90E+05	4.77E+05 3.90E+05		
CV or beta (Min Qty, Max Qty)	0.29 0.29	0.17 0.17	0.17 0.17		
Quantity Unit:	Each	Each	Each		
Repair Time:	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀
Repair Time by Damage State:	1.65E+00 2.47E+00 3.50E+00	2.65E+01 3.12E+01 4.07E+01	2.65E+01 3.12E+01 4.07E+01		
Best fit mean:	2.47E+00	3.12E+01	3.12E+01		
Best Fit Distribution:	LogNormal	LogNormal	LogNormal		
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00	1.00 5.00	1.00 5.00		
Average Repair Time (Min Qty, Max Qty)	2.72E+00 2.22E+00	7.58E+01 1.56E+01	7.58E+01 1.56E+01		
CV or beta (Min Qty, Max Qty)	0.38 0.38	0.30 0.30	0.30 0.30		
Quantity Unit:	Each	Each	Each		
LifeSafety Hazard:					
Potential non-collapse casualties? (Yes / No)	NO	NO	NO		
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable	Not Applicable	Not Applicable		
Serious Injury (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00		
Loss of Life (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00		
Post-event Tagging Flag:	NO	NO	NO		
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00		

Comments:
Date Created:
Approved (YES / NO)?
Official (YES / NO) ?
Author:
Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.
Not Given
By User
By User
Not Given
2016-10-25 - Repair method clarified.

Root Cost Multiplier: 1

2016-10-25 - Repair method clarified.

Root Cost Multiplier: 1

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.		
Date Created:	Not Given	Root Cost Multiplier:	1
Approved (YES / NO)?	By User		
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	2016-10-25 - Repair method clarified.		

[illegible]

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.013e

Chiller - Capacity: 100 to <350 Ton - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility only

Line 443

Costing is per unit and is based upon 250 Ton.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

TN 250

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

YES

BLDG

No

Illustrations



D3031.013a-DS1-1.JPG

Damage State Probability:

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

0.72

0.2

0.1

0.2

NO

NO

Average

Average

Superior

Superior

Repair chiller and attached piping. Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Each

P₁₀

P₅₀

P₉₀

1.31E+05

1.53E+05

1.99E+05

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Each

P₁₀

P₅₀

P₉₀

2.02E+01

2.36E+01

3.08E+01

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

None

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.013f
Chiller - Capacity: 100 to <350 Ton - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/isolator & eq
Costing is per unit and is based upon 250 Ton.

Line 444

Construction Quality: Normal - Designed for seismic loads but no special seismic certification

Seismic Installation Conditions: Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

Quantity Rounding: YES

Fragility Unit of Measure: TN 250

Allow sum by floor or building? BLDG

Demand Parameter (unit): Peak Floor Acceleration g

Demand Location (floor above?) No

Number of Damage States: 3


Damage State: DS1 DS2 DS3

Type of Damage State: Mutually Exclusive Mutually Exclusive Mutually Exclusive

DS Hierarchy: MutEx(DS1,DS2,DS3)

Descriptions: Anchorage failure. Anchorage failure & Equipment damaged beyond repair. Damaged, Inoperative but anchorage is OK.

Illustrations



D3031.013a-DS1-1.JPG

none

none

Damage State Probability: 0.35 0.15 0.50

Fragility Parameters

Median Demand, θ : By User

Data dispersion, β_d : User to Calculate

Uncertainty, β_u : User to Calculate

Total Dispersion, β : By User

Correlation (Yes / No): NO

Directionality (Yes / No): NO

Quality Ratings

Data Quality: Average

Data Relevance: Average

Documentation Quality: Superior

Rationality: Superior

Consequence Functions

Repair Description: Repair anchorage and concrete pad and remount equipment. Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Chiller removed, repaired offsite, and reinstalled. Repair chiller and attached piping. Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES YES YES

Repair Costs:

Repair Cost by Damage State: 8.00E+02 1.50E+03 2.40E+03 1.31E+05 1.55E+05 2.02E+05 1.31E+05 1.55E+05 2.02E+05

Best fit mean: 1.57E+03 1.80E+05 1.60E+05

Best Fit Distribution: Normal LogNormal LogNormal

Quantity Plateau (Min Qty, Max Qty): 1.00 5.00 1.00 5.00 1.00 5.00

Average Repair Cost (Min Qty, Max Qty): 1.65E+03 1.35E+03 1.70E+05 1.39E+05 1.70E+05 1.39E+05

CV or beta (Min Qty, Max Qty): 0.40 0.40 0.17 0.17 0.17 0.17

Quantity Unit: Each Each Each

Repair Time:

Repair Time by Damage State: 9.41E-01 1.76E+00 2.82E+00 1.54E+01 1.82E+01 2.37E+01 2.32E+01 2.73E+01 3.56E+01

Best fit mean: 1.76E+00 1.82E+01 2.73E+01

Best Fit Distribution: Normal LogNormal LogNormal

Quantity Plateau (Min Qty, Max Qty): 1.00 5.00 1.00 5.00 1.00 5.00

Average Repair Time (Min Qty, Max Qty): 1.94E+00 1.59E+00 3.64E+01 9.09E+00 4.54E+01 1.36E+01

CV or beta (Min Qty, Max Qty): 0.47 0.47 0.30 0.30 0.30 0.30

Quantity Unit: Each Each Each

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No): NO NO NO

Casualty-affected Planar Area (sf) per Normative Unit: Not Applicable Not Applicable Not Applicable

Serious Injury (Median, Dispersion): 0% 0.00 0% 0.00 0% 0.00

Loss of Life (Median, Dispersion): 0% 0.00 0% 0.00 0% 0.00

Post-event Tagging Flag: NO NO NO

Unsafe Placard Trigger (Median, Dispersion): 0% 0.00 0% 0.00 0% 0.00

Comments: User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO)? By User

Author: Not Given

Revisions: 2016-10-25 - Repair method clarified.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.013g

Chiller - Capacity: 350 to <750 Ton - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragility only

Costing is per unit and is based upon 500 Ton.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

TN 500

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

MutEx(DS1,DS2)

Anchorage failure.

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

YES

BLDG

No

Illustrations



D3031.013a-DS1-1.JPG

none

Damage State Probability:

0.70

0.30

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β_t :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User

User to Calculate

User to Calculate

By User

NO

NO

Average

Average

Superior

Superior

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.40E+03

2.20E+03

3.10E+03

2.19E+05

2.57E+05

3.36E+05

2.23E+03

Normal

1.00

5.00

1.00

5.00

2.42E+03

1.98E+03

2.83E+05

2.32E+05

0.30

0.30

0.17

0.17

Each

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.44E+00

2.26E+00

3.19E+00

2.25E+01

2.65E+01

3.46E+01

2.26E+00

Normal

1.00

5.00

1.00

5.00

2.49E+00

2.04E+00

5.30E+01

1.32E+01

0.39

0.39

0.30

0.30

Each

Each

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

0%

0.00

NO

NO

0%

0.00

0%

0.00

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.013h

Chiller - Capacity: 350 to <750 Ton - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility only

Line 446

Costing is per unit and is based upon 500 Ton.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

TN 500

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations



D3031.013a-DS1-1.JPG

Damage State Probability:

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

0.72

0.2

0.1

0.2

NO

NO

Average

Average

Superior

Superior

Repair chiller and attached piping. Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Each

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Each

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.17E+05

2.55E+05

3.33E+05

2.64E+05

LogNormal

1.00

5.00

2.81E+05

2.30E+05

0.17

0.17

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.56E+01

3.00E+01

3.91E+01

3.00E+01

LogNormal

1.00

5.00

6.00E+01

1.50E+01

0.30

0.30

Each

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

None

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.013i

Chiller - Capacity: 350 to <750 Ton - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/isolator & eq

Line 447

Costing is per unit and is based upon 500 Ton.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

TN 500

Peak Floor Acceleration

g

3

DS1

DS2

DS3

Mutually Exclusive

Mutually Exclusive

Mutually Exclusive

MutEx(DS1,DS2,DS3)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Damaged, Inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES


Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations



D3031.013a-DS1-1.JPG

none

0.35

none

0.15

none

0.50

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

NO

NO

Average

Average

Superior

Superior

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Chiller removed, repaired offsite, and reinstalled.

Repair chiller and attached piping. Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

YES

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.40E+03

2.20E+03

3.10E+03

2.19E+05

2.57E+05

3.36E+05

2.19E+05

2.57E+05

3.36E+05

2.23E+03

Normal

1.00

5.00

1.00

5.00

1.00

5.00

2.42E+03

1.98E+03

2.83E+05

2.32E+05

2.83E+05

2.32E+05

0.30

0.30

0.17

0.17

0.17

0.17

Each

Each

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.65E-01

2.59E-01

3.65E-01

2.57E+01

3.03E+01

3.95E+01

2.57E+01

3.03E+01

3.95E+01

2.59E-01

Normal

1.00

5.00

1.00

5.00

1.00

5.00

2.85E-01

2.33E-01

3.33E+01

2.73E+01

3.33E+01

2.73E+01

0.39

0.39

0.30

0.30

0.30

0.30

Each

Each

Each

NO

NO

NO

Not Applicable

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

0%

0.00

NO

NO

NO

0%

0.00

0%

0.00

0%

0.00

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.013j

Chiller - Capacity: 750 to <1000 Ton - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragility only

Costing is per unit and is based upon 850 Ton.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

TN 850

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

MutEx(DS1,DS2)

Anchorage failure.

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations



D3031.013a-DS1-1.JPG

none

0.70

0.30

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β_t :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User

User to Calculate

User to Calculate

By User

NO

NO

Average

Average

Superior

Superior

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Chiller removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.60E+03

2.40E+03

3.40E+03

3.67E+05

4.33E+05

5.65E+05

2.36E+03

LogNormal

1.00

5.00

1.00

5.00

2.64E+03

2.16E+03

4.77E+05

3.90E+05

0.29

0.29

0.17

0.17

Each

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.65E+00

2.47E+00

3.50E+00

2.65E+01

3.12E+01

4.07E+01

2.47E+00

LogNormal

1.00

5.00

1.00

5.00

2.72E+00

2.22E+00

7.58E+01

1.56E+01

0.38

0.38

0.30

0.30

Each

Each

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

0%

0.00

NO

NO

0%

0.00

0%

0.00

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name


Description

D3031.013I
Chiller - Capacity: 750 to <1000 Ton - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/isolator & e
Costing is per unit and is based upon 850 Ton.

Line 450

Construction Quality:	Normal - Designed for seismic loads but no special seismic certification			
Seismic Installation Conditions:	Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints			
Fragility Unit of Measure:	TN 850			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive	
DS Hierarchy	MutEx(DS1,DS2,DS3)			
Descriptions	Anchorage failure.	Anchorage failure & Equipment damaged beyond repair.	Damaged, Inoperative but anchorage is OK.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		BLDG
Demand Location (floor above?)		No

Illustrations				
	D3031.013a-DS1-1.JPG	none	none	
Damage State Probability:	0.35	0.15	0.50	
Fragility Parameters				
Median Demand, θ :	By User	By User	By User	
Data dispersion, β_d :	User to Calculate	User to Calculate	User to Calculate	
Uncertainty, β_u :	User to Calculate	User to Calculate	User to Calculate	
Total Dispersion, β :	By User	By User	By User	
Correlation (Yes / No)	NO			
Directionality (Yes / No)	NO			
Quality Ratings				
Data Quality	Average			
Data Relevance	Average			
Documentation Quality	Superior			
Rationality	Superior			
Consequence Functions				
Repair Description	Repair anchorage and concrete pad and remount equipment.	Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Chiller removed, repaired offsite, and reinstalled.	Repair chiller and attached piping. Chiller removed, repaired offsite, and reinstalled.	

Long Lead Time (Yes / No)	YES	YES	YES		
Repair Costs:					
Repair Cost by Damage State:	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀
Best fit mean:	1.60E+03 2.40E+03 3.40E+03	3.67E+05 4.33E+05 5.65E+05	3.67E+05 4.33E+05 5.65E+05		
Best Fit Distribution:	2.36E+03 LogNormal	4.48E+05 LogNormal	4.48E+05 LogNormal		
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00	1.00 5.00	1.00 5.00		
Average Repair Cost (Min Qty, Max Qty)	2.64E+03 2.16E+03	4.77E+05 3.90E+05	4.77E+05 3.90E+05		
CV or beta (Min Qty, Max Qty)	0.29 0.29	0.17 0.17	0.17 0.17		
Quantity Unit:	Each	Each	Each		
Repair Time:					
Repair Time by Damage State:	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀
Best fit mean:	1.88E-01 2.82E-01 4.00E-01	3.02E+00 3.57E+00 4.65E+00	3.02E+00 3.57E+00 4.65E+00		
Best Fit Distribution:	2.82E-01 LogNormal	3.57E+00 LogNormal	3.57E+00 LogNormal		
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00	1.00 5.00	1.00 5.00		
Average Repair Time (Min Qty, Max Qty)	3.11E-01 2.54E-01	8.67E+00 1.78E+00	8.67E+00 1.78E+00		
CV or beta (Min Qty, Max Qty)	0.38 0.38	0.30 0.30	0.30 0.30		
Quantity Unit:	Each	Each	Each		
LifeSafety Hazard:					
Potential non-collapse casualties? (Yes / No)	NO	NO	NO		
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable	Not Applicable	Not Applicable		
Serious Injury (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00		
Loss of Life (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00		
Post-event Tagging Flag:	NO	NO	NO		
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00		
Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.				
Date Created:	Not Given			Root Cost Multiplier:	1
Approved (YES / NO)?	By User				
Official (YES / NO) ?	By User				
Author:	Not Given				
Revisions:	2016-10-25 - Repair method clarified.				

Root Cost Multiplier: 1

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.022c

Line 457

Cooling Tower - Capacity: < 100 Ton - Vibration isolated equipment that is not snubbed or restrained - Combined anchorage/isolator & equipment fragility

Costing is per unit and is based upon 75 Ton.

Construction Quality:	Normal - Not designed for seismic loads			
Seismic Installation Conditions:	Vibration isolated equipment that is not snubbed or restrained			
Fragility Unit of Measure:	TN 75			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive	
DS Hierarchy	MutEx(DS1,DS2,DS3)			
Descriptions	Anchorage failure.	Anchorage failure & Equipment damaged beyond repair.	Damaged equipment and attached piping but anchorage OK.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		BLDG
Demand Location (floor above?)	No	

Illustrations					
	none	none	none		
Damage State Probability:	0.35	0.15	0.50		

Fragility Parameters					
Median Demand, θ :	By User	By User	By User		
Data dispersion, β_d :	User to Calculate	User to Calculate	User to Calculate		
Uncertainty, β_u :	User to Calculate	User to Calculate	User to Calculate		
Total Dispersion, β :	By User	By User	By User		

Correlation (Yes / No)
Directionality (Yes / No)
Quality Ratings
Data Quality
Data Relevance
Documentation Quality
Rationality
Consequence Functions
Repair Description

NO
NO
Average
Average
Superior
Superior
Repair anchorage and concrete pad and remount equipment.
Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Cooling tower removed, repaired offsite, and reinstalled.
Repair damaged equipment and attached piping. Cooling tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)	NO	YES	NO		
Repair Costs:	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀
Repair Cost by Damage State:	5.00E+02 1.00E+03 1.70E+03	2.06E+04 2.47E+04 3.25E+04	2.01E+04 2.37E+04 3.08E+04		
Best fit mean:	9.59E+02	2.55E+04	2.45E+04		
Best Fit Distribution:	LogNormal	LogNormal	LogNormal		
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00	1.00 5.00	1.00 5.00		
Average Repair Cost (Min Qty, Max Qty)	1.10E+03 9.00E+02	2.72E+04 2.22E+04	2.61E+04 2.13E+04		
CV or beta (Min Qty, Max Qty)	0.45 0.45	0.18 0.18	0.17 0.17		
Quantity Unit:	Each	Each	Each		
Repair Time:	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀
Repair Time by Damage State:	5.88E-01 1.18E+00 2.00E+00	4.85E+00 5.81E+00 7.65E+00	4.73E+00 5.58E+00 7.25E+00		
Best fit mean:	1.18E+00	5.81E+00	5.58E+00		
Best Fit Distribution:	LogNormal	LogNormal	LogNormal		
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00	1.00 5.00	1.00 5.00		
Average Repair Time (Min Qty, Max Qty)	1.29E+00 1.06E+00	8.72E+00 2.91E+00	8.36E+00 2.79E+00		
CV or beta (Min Qty, Max Qty)	0.52 0.52	0.31 0.31	0.30 0.30		
Quantity Unit:	Each	Each	Each		
LifeSafety Hazard:					
Potential non-collapse casualties? (Yes / No)	NO	NO	NO		
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable	Not Applicable	Not Applicable		
Serious Injury (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00		
Loss of Life (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00		
Post-event Tagging Flag:	NO	NO	NO		
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00		
Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.				
Date Created:	Not Given				
Approved (YES / NO)?	By User				
Official (YES / NO) ?	By User				
Author:	Not Given				
Revisions:	2016-10-25 - Repair method clarified.				

Root Cost Multiplier: 1

Root Cost Multiplier: 1

Root Cost Multiplier: 1

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.		
Date Created:	Not Given	Root Cost Multiplier:	1
Approved (YES / NO)?	By User		
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	2016-10-25 - Repair method clarified.		

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.		
Date Created:	Not Given	Root Cost Multiplier:	1
Approved (YES / NO)?	By User		
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	2016-10-25 - Repair method clarified.		

Root Cost Multiplier: 1

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.		
Date Created:	Not Given	Root Cost Multiplier:	1
Approved (YES / NO)?	By User		
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	2016-10-25 - Repair method clarified.		

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.		
Date Created:	Not Given	Root Cost Multiplier:	1
Approved (YES / NO)?	By User		
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	2016-10-25 - Repair method clarified.		

[illegible]

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.023h

Cooling Tower - Capacity: 350 to <750 Ton - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility only

Costing is per unit and is based upon 500 Ton.

Construction Quality:

Normal - Designed for seismic loads but no special seismic certification

Seismic Installation Conditions:

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

Quantity Rounding

Round Qty?

YES

Fragility Unit of Measure:

TN 500

Allow sum by floor or building?

BLDG

Demand Parameter (unit):

Peak Floor Acceleration

g

Demand Location (floor above?)

No

Number of Damage States:

1

Damage State:

DS1

Type of Damage State:

Sequential

DS Hierarchy

Seq(DS1)

Descriptions

Damaged equipment and attached piping but anchorage is OK.

Illustrations					
	none				

Damage State Probability:

1.00

Fragility Parameters

Median Demand, θ :

1.52

Data dispersion, β_d :

0.4

Uncertainty, β_u :

0.1

Total Dispersion, β :

0.4

Correlation (Yes / No)

NO

Directionality (Yes / No)

NO

Quality Ratings

Average

Data Quality

Average

Data Relevance

Superior

Documentation Quality

Superior

Rationality

Consequence Functions

Repair Description

Repair damaged equipment and attached piping. Cooling tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No) YES

Repair Costs:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}												
Repair Cost by Damage State:	1.10E+05	1.30E+05	1.71E+05																								
Best fit mean:	1.35E+05																										
Best Fit Distribution:	LogNormal																										
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00																										
Average Repair Cost (Min Qty, Max Qty)	1.43E+05 1.17E+05																										
CV or beta (Min Qty, Max Qty)	0.18 0.18																										
Quantity Unit:	Each																										
Repair Time:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}												
Repair Time by Damage State:	1.30E+01	1.53E+01	2.01E+01																								
Best fit mean:	1.53E+01																										
Best Fit Distribution:	LogNormal																										
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00																										
Average Repair Time (Min Qty, Max Qty)	3.06E+01 7.66E+00																										
CV or beta (Min Qty, Max Qty)	0.31 0.31																										
Quantity Unit:	Each																										
LifeSafety Hazard:																											
Potential non-collapse casualties? (Yes / No)	NO																										
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable																										
Serious Injury (Median, Dispersion)	0% 0.00																										
Loss of Life (Median, Dispersion)	0% 0.00																										
Post-event Tagging Flag:	NO																										
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00																										
Comments:	None																										
Date Created:	Not Given																										
Approved (YES / NO)?	By User																										
Official (YES / NO) ?	By User																										
Author:	Not Given																										
Revisions:	2016-10-25 - Repair method clarified.																										

Root Cost Multiplier:

1

2016-10-25 - Repair method clarified.

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.023j

Cooling Tower - Capacity: 750 to <1000 Ton - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragility only

Costing is per unit and is based upon 850 Ton.

Line 476

Construction Quality:Normal - Designed for seismic loads but no special seismic certification

Seismic Installation Conditions:Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

Quantity RoundingRound Qty?YES

Fragility Unit of Measure:TN 850

Allow sum by floor or building?BLDG

Demand Parameter (unit):Peak Floor Accelerationg

Demand Location (floor above?)No

Number of Damage States:2

Damage State:DS1DS2

Type of Damage State:Mutually ExclusiveMutually Exclusive

DS HierarchyMutEx(DS1,DS2)

DescriptionsAnchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Illustrations					
	none	none			
	0.70	0.30			

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User

User to Calculate

User to Calculate

By User

NO

NO

Average

Average

Superior

Superior

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Cooling tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.60E+03

2.40E+03

3.40E+03

1.87E+05

2.21E+05

2.88E+05

2.36E+03

2.28E+05

1.00

5.00

1.00

5.00

2.64E+03

2.16E+03

2.43E+05

1.99E+05

0.29

0.29

0.17

0.17

Each

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.88E+00

2.82E+00

4.00E+00

1.54E+01

1.82E+01

2.37E+01

2.82E+00

1.82E+01

1.00

5.00

1.00

5.00

3.11E+00

2.54E+00

4.42E+01

9.10E+00

0.38

0.38

0.30

0.30

Each

Each

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

0%

0.00

NO

NO

0%

0.00

0%

0.00

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Root Cost Multiplier:1

2016-10-25 - Repair method clarified.

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3031.023k

Line 477

Cooling Tower - Capacity: 750 to <1000 Ton - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

Costing is per unit and is based upon 850 Ton.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

TN 850

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Damaged equipment and attached piping but anchorage is OK.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

YES

BLDG

No

Illustrations

Damage State Probability:

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.52

0.4

0.1

0.4

NO

NO

Average

Average

Superior

Superior

Repair damaged equipment and attached piping. Cooling tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.86E+05

2.19E+05

2.85E+05

2.26E+05

LogNormal

1.00

5.00

2.40E+05

1.97E+05

0.17

0.17

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.53E+01

1.80E+01

2.35E+01

1.80E+01

LogNormal

1.00

5.00

4.37E+01

9.00E+00

0.30

0.30

Each

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

None

Not Given

By User

By User

Not Given

2016-10-25 - Repair method clarified.

Root Cost Multiplier:

1

Dispersion)	0%	0.00	0%	0.00	0%	0.00	
Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.						
Date Created:	Not Given						Root Cost Multiplier: 1
Approved (YES / NO)?	By User						
Official (YES / NO) ?	By User						
Author:	Not Given						
Revisions:	2016-10-25 - Repair method clarified.						

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3032.012b

Compressor - Capacity: Small non medical air supply - Vibration isolated equipment that is not snubbed or restrained - Equipment fragility only

Costing is per unit.

Line 484

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

EA 1

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

MutEx(DS1,DS2)

Equipment does not function but anchorage is OK. Motor is damaged.

Equipment does not function but anchorage is OK. Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

YES

BLDG

No

Illustrations

D3032.011a-DS1-1.JPG

none

Damage State Probability:

0.50

0.50

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

NO

NO

Average

Average

Superior

Superior

Repair motor.

Replace equipment.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau

(Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Each

Each

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau

(Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Each

Each

LifeSafety Hazard:

Potential non-collapse casualties?

(Yes / No)

Casualty-affected Planar Area (sf)

per Normative Unit:

Not Applicable

Not Applicable

Serious Injury (Median, Dispersion)

0%

0.00

0%

0.00

Loss of Life (Median, Dispersion)

0%

0.00

0%

0.00

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

0%

0.00

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.		
Date Created:	Not Given	Root Cost Multiplier:	1
Approved (YES / NO)?	By User		
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	None		

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3032.012e

Compressor - Capacity: Large non medical air supply - Vibration isolated equipment that is not snubbed or restrained - Equipment fragility only

Costing is per unit.

Line 487

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

EA 1

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

MutEx(DS1,DS2)

Equipment does not function but anchorage is OK. Motor is damaged.

Equipment does not function but anchorage is OK. Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

YES

BLDG

No

Illustrations



D3032.011a-DS1-1.JPG

none

Damage State Probability:

0.50

0.50

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

NO

NO

Average

Average

Superior

Superior

Repair motor.

Replace equipment.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.55E+03

3.00E+03

3.90E+03

6.66E+03

8.00E+03

1.07E+04

3.10E+03

LogNormal

1.00

5.00

1.00

5.00

3.30E+03

2.70E+03

8.80E+03

7.20E+03

0.17

0.17

0.19

0.19

Each

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.00E+00

3.53E+00

4.59E+00

7.84E-01

9.41E-01

1.26E+00

3.53E+00

LogNormal

1.00

5.00

1.00

5.00

3.88E+00

3.18E+00

1.88E+00

4.71E-01

0.30

0.30

0.32

0.32

Each

Each

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

NO

NO

0%

0.00

0%

0.00

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3032.012h

Compressor - Capacity: Small medical quality air supply - Vibration isolated equipment that is not snubbed or restrained - Equipment fragility only

Costing is per unit.

Construction Quality:

Normal - Not designed for seismic loads

Seismic Installation Conditions:

Vibration isolated equipment that is not snubbed or restrained

Fragility Unit of Measure:

EA 1

Demand Parameter (unit):

Peak Floor Acceleration

g

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Mutually Exclusive

Mutually Exclusive

DS Hierarchy

MutEx(DS1,DS2)

Descriptions

Equipment does not function but anchorage is OK. Motor is damaged.

Equipment does not function but anchorage is OK. Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations



D3032.011a-DS1-1.JPG

none

Damage State Probability:

0.50

0.50

Fragility Parameters

Median Demand, θ :

0.47

0.47

Data dispersion, β_d :

0.2

0.20

Uncertainty, β_u :

0.1

0.1

Total Dispersion, β :

0.2

0.2

Correlation (Yes / No)

NO

Directionality (Yes / No)

NO

Quality Ratings

Data Quality

Average

Data Relevance

Average

Documentation Quality

Superior

Rationality

Superior

Consequence Functions

Repair Description

Repair motor.

Replace equipment.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

P₁₀

P₅₀

P₉₀

7.70E+02

9.00E+02

1.17E+03

P₁₀

P₅₀

P₉₀

6.61E+03

8.20E+03

1.14E+04

Best fit mean:

9.32E+02

8.50E+03

Best Fit Distribution:

LogNormal

LogNormal

Quantity Plateau (Min Qty, Max Qty)

1.00

5.00

1.00

5.00

Average Repair Cost (Min Qty, Max Qty)

9.90E+02

8.10E+02

9.02E+03

7.38E+03

CV or beta (Min Qty, Max Qty)

0.17

0.17

0.22

0.22

Quantity Unit:

Each

Each

Repair Time:

Repair Time by Damage State:

P₁₀

P₅₀

P₉₀

9.06E-01

1.06E+00

1.38E+00

P₁₀

P₅₀

P₉₀

7.78E-01

9.65E-01

1.34E+00

Best fit mean:

1.06E+00

9.65E-01

Best Fit Distribution:

LogNormal

LogNormal

Quantity Plateau (Min Qty, Max Qty)

1.00

5.00

1.00

5.00

Average Repair Time (Min Qty, Max Qty)

1.16E+00

9.53E-01

1.93E+00

4.82E-01

CV or beta (Min Qty, Max Qty)

0.30

0.30

0.33

0.33

Quantity Unit:

Each

Each

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

NO

NO

Casualty-affected Planar Area (sf) per Normative Unit:

Not Applicable

Not Applicable

Serious Injury (Median, Dispersion)

0%

0.00

0%

0.00

Loss of Life (Median, Dispersion)

0%

0.00

0%

0.00

Post-event Tagging Flag:

NO

NO

Unsafe Placard Trigger (Median, Dispersion)

0%

0.00

0%

0.00

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

None

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3032.012i


Compressor - Capacity: Small medical quality air supply - Vibration isolated equipment that is not snubbed or restrained - Combined anchorage/isolator & equipment fra

Costing is per unit.

Line 491

Construction Quality:	Normal - Not designed for seismic loads			
Seismic Installation Conditions:	Vibration isolated equipment that is not snubbed or restrained			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	4			
Damage State:	DS1	DS2	DS3	DS4
Type of Damage State:	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive
DS Hierarchy	MutEx(DS1,DS2,DS3,DS4)			
Descriptions	Anchorage failure.	Anchorage failure & Equipment damaged beyond repair.	Motor damaged but anchorage is OK.	Equipment damaged beyond repair but anchorage is OK.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		BLDG
Demand Location (floor above?)		No

Illustrations					
	D3032.011a-DS1-1.JPG	none	none	none	
Damage State Probability:	0.35	0.15	0.25	0.25	
Fragility Parameters					
Median Demand, θ :	By User	By User	By User	By User	
Data dispersion, β_d :	User to Calculate	User to Calculate	User to Calculate	User to Calculate	
Uncertainty, β_u :	User to Calculate	User to Calculate	User to Calculate	User to Calculate	
Total Dispersion, β_t :	By User	By User	By User	By User	
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Average				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Repair anchorage and concrete pad and remount equipment.	Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.	Repair Motor - Anchorage and Concrete do not require replacement	Replace and install equipment including new anchorage if anchorage is post-installed.	

Long Lead Time (Yes / No)	NO	YES	NO	YES	
Repair Costs:					
Repair Cost by Damage State:	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀
Best fit mean:	2.50E+02 4.50E+02 9.50E+02	6.86E+03 8.65E+03 1.23E+04	7.70E+02 9.00E+02 1.17E+03	6.86E+03 8.65E+03 1.23E+04	
Best Fit Distribution:	4.68E+02 LogNormal	8.99E+03 LogNormal	9.32E+02 LogNormal	8.99E+03 LogNormal	
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00	1.00 5.00	1.00 5.00	1.00 5.00	
Average Repair Cost (Min Qty, Max Qty)	4.95E+02 4.05E+02	9.52E+03 7.79E+03	9.90E+02 8.10E+02	9.52E+03 7.79E+03	
CV or beta (Min Qty, Max Qty)	0.55 0.55	0.24 0.24	0.17 0.17	0.24 0.24	
Quantity Unit:	Each	Each	Each	Each	
Repair Time:					
Repair Time by Damage State:	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀
Best fit mean:	8.82E-02 1.59E-01 3.35E-01	2.42E+00 3.05E+00 4.35E+00	2.72E-01 3.18E-01 4.13E-01	2.42E+00 3.05E+00 4.35E+00	
Best Fit Distribution:	1.59E-01 LogNormal	3.05E+00 LogNormal	3.18E-01 LogNormal	3.05E+00 LogNormal	
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00	1.00 5.00	1.00 5.00	1.00 5.00	
Average Repair Time (Min Qty, Max Qty)	1.75E-01 1.43E-01	3.36E+00 2.75E+00	3.49E-01 2.86E-01	3.36E+00 2.75E+00	
CV or beta (Min Qty, Max Qty)	0.60 0.60	0.35 0.35	0.30 0.30	0.35 0.35	
Quantity Unit:	Each	Each	Each	Each	
LifeSafety Hazard:					
Potential non-collapse casualties? (Yes / No)	NO	NO	NO	NO	
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable	Not Applicable	Not Applicable	Not Applicable	
Serious Injury (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00	0% 0.00	
Loss of Life (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00	0% 0.00	
Post-event Tagging Flag:	NO	NO	NO	NO	
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00	0% 0.00	
Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.				
Date Created:	Not Given				Root Cost Multiplier: 1
Approved (YES / NO)?	By User				
Official (YES / NO) ?	By User				
Author:	Not Given				
Revisions:	None				

Root Cost Multiplier: 1

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name


Description

D3032.012I
Compressor - Capacity: Large medical quality air supply - Vibration isolated equipment that is not snubbed or restrained - Combined anchorage/isolator & equipment fra
Costing is per unit.

Line 494

Construction Quality:	Normal - Not designed for seismic loads			
Seismic Installation Conditions:	Vibration isolated equipment that is not snubbed or restrained			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	4			
Damage State:	DS1	DS2	DS3	DS4
Type of Damage State:	Mutually Exclusive		Mutually Exclusive	
DS Hierarchy	MutEx(DS1,DS2,DS3,DS4)			
Descriptions	Anchorage failure.		Motor damaged but anchorage is OK.	Equipment damaged beyond repair but anchorage is OK.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		BLDG
Demand Location (floor above?)		No

Illustrations					
	D3032.011a-DS1-1.JPG	none	none	none	
Damage State Probability:	0.35	0.15	0.25	0.25	
Fragility Parameters					
Median Demand, θ :	By User	By User	By User	By User	
Data dispersion, β_d :	User to Calculate	User to Calculate	User to Calculate	User to Calculate	
Uncertainty, β_u :	User to Calculate	User to Calculate	User to Calculate	User to Calculate	
Total Dispersion, β_t :	By User	By User	By User	By User	
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Average				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Repair anchorage and concrete pad and remount equipment.	Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.	Replace Motor - Anchorage and Concrete do not require replacement	Replace and install equipment including new anchorage if anchorage is post-installed.	

Long Lead Time (Yes / No)	NO			YES			NO			YES		
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	5.50E+02	8.50E+02	1.60E+03	2.54E+04	3.09E+04	4.15E+04	3.40E+03	4.00E+03	5.20E+03	2.54E+04	3.09E+04	4.15E+04
Best fit mean:	8.98E+02			3.19E+04			4.13E+03			3.19E+04		
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal		
Quantity Plateau (Min Qty, Max Qty)	1.00	5.00		1.00	5.00		1.00	5.00		1.00	5.00	
Average Repair Cost (Min Qty, Max Qty)	9.35E+02	7.65E+02		3.39E+04	2.78E+04		4.40E+03	3.60E+03		3.39E+04	2.78E+04	
CV or beta (Min Qty, Max Qty)	0.44	0.44		0.20	0.20		0.17	0.17		0.20	0.20	
Quantity Unit:	Each			Each			Each			Each		
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.94E-01	3.00E-01	5.65E-01	8.97E+00	1.09E+01	1.47E+01	1.20E+00	1.41E+00	1.84E+00	8.97E+00	1.09E+01	1.47E+01
Best fit mean:	3.00E-01			1.09E+01			1.41E+00			1.09E+01		
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal		
Quantity Plateau (Min Qty, Max Qty)	1.00	5.00		1.00	5.00		1.00	5.00		1.00	5.00	
Average Repair Time (Min Qty, Max Qty)	3.30E-01	2.70E-01		1.20E+01	9.80E+00		1.55E+00	1.27E+00		1.20E+01	9.80E+00	
CV or beta (Min Qty, Max Qty)	0.51	0.51		0.32	0.32		0.30	0.30		0.32	0.32	
Quantity Unit:	Each			Each			Each			Each		
LifeSafety Hazard:												
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO		
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable		
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00	
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00	
Post-event Tagging Flag:	NO			NO			NO			NO		
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00	
Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.											
Date Created:	Not Given											
Approved (YES / NO)?	By User											
Official (YES / NO) ?	By User											
Author:	Not Given											
Revisions:	None											
											Root Cost Multiplier:	1

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3032.013a

Compressor - Capacity: Small non medical air supply - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragili

Line 495

Costing is per unit.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

EA 1

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

Mutually Exclusive

MutEx(DS1,DS2)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

Allow sum by floor or building?


Demand Location (floor above?)

YES

BLDG

No

Illustrations



D3032.011a-DS1-1.JPG

none

0.70

0.30

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User

User to Calculate

User to Calculate

By User

NO

NO

Average

Average

Superior

Superior

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.50E+02

4.50E+02

9.50E+02

2.46E+03

3.15E+03

4.63E+03

4.68E+02

LogNormal

1.00

5.00

1.00

5.00

4.95E+02

4.05E+02

0.55

0.55

3.47E+03

2.84E+03

0.26

0.26

Each

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

8.82E-02

1.59E-01

3.35E-01

8.68E-01

1.11E+00

1.63E+00

1.59E-01

LogNormal

1.00

5.00

1.00

5.00

1.75E-01

1.43E-01

0.60

0.60

1.22E+00

1.00E+00

0.36

0.36

Each

Each

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

NO

NO

0%

0.00

0%

0.00

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Root Cost Multiplier:

1


Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification	D3032.013c	Line 497
NISTIR Name	Compressor - Capacity: Small non medical air supply - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined ancho	
Description	Costing is per unit.	

Construction Quality:	Normal - Designed for seismic loads but no special seismic certification			
Seismic Installation Conditions:	Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	4			
Damage State:	DS1	DS2	DS3	DS4
Type of Damage State:	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive
DS Hierarchy	MutEx(DS1,DS2,DS3,DS4)			
Descriptions	Anchorage failure.	Anchorage failure & Equipment damaged beyond repair.	Motor damaged but anchorage is OK.	Equipment damaged beyond repair but anchorage is OK.

Quantity Rounding	Round Qty?	YES
	Allow sum by floor or building?	BLDG
	Demand Location (floor above?)	No

Illustrations					
	D3032.011a-DS1-1.JPG	none	none	none	
Damage State Probability:	0.35	0.15	0.25	0.25	
Fragility Parameters					
Median Demand, θ:	By User	By User	By User	By User	
Data dispersion, β_d:	User to Calculate	User to Calculate	User to Calculate	User to Calculate	
Uncertainty, β_u:	User to Calculate	User to Calculate	User to Calculate	User to Calculate	
Total Dispersion, β_t:	By User	By User	By User	By User	
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Average				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Repair anchorage and concrete pad and remount equipment.	Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.	Repair Motor - Anchorage and Concrete do not require repair.	Replace and install equipment including new anchorage if anchorage is post-installed.	

Long Lead Time (Yes / No)	NO	YES	NO	YES	
Repair Costs:	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}
Repair Cost by Damage State:	2.50E+02 4.50E+02 9.50E+02	2.46E+03 3.15E+03 4.63E+03	6.40E+02 7.50E+02 9.80E+02	2.46E+03 3.15E+03 4.63E+03	
Best fit mean:	4.68E+02	3.29E+03	7.77E+02	3.29E+03	
Best Fit Distribution:	LogNormal	LogNormal	LogNormal	LogNormal	
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00	1.00 5.00	1.00 5.00	1.00 5.00	
Average Repair Cost (Min Qty, Max Qty)	4.95E+02 4.05E+02	3.47E+03 2.84E+03	8.25E+02 6.75E+02	3.47E+03 2.84E+03	
CV or beta (Min Qty, Max Qty)	0.55 0.55	0.26 0.26	0.17 0.17	0.26 0.26	
Quantity Unit:	Each	Each	Each	Each	
Repair Time:	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}
Repair Time by Damage State:	2.94E-01 5.29E-01 1.12E+00	8.68E-01 1.11E+00 1.63E+00	7.53E-01 8.82E-01 1.15E+00	2.89E+00 3.71E+00 5.45E+00	
Best fit mean:	5.29E-01	1.11E+00	8.82E-01	3.71E+00	
Best Fit Distribution:	LogNormal	LogNormal	LogNormal	LogNormal	
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00	1.00 5.00	1.00 5.00	1.00 5.00	
Average Repair Time (Min Qty, Max Qty)	5.82E-01 4.76E-01	1.48E+00 7.41E-01	9.71E-01 7.94E-01	4.08E+00 3.34E+00	
CV or beta (Min Qty, Max Qty)	0.60 0.60	0.36 0.36	0.30 0.30	0.36 0.36	
Quantity Unit:	Each	Each	Each	Each	
LifeSafety Hazard:					
Potential non-collapse casualties? (Yes / No)	NO	NO	NO	NO	
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable	Not Applicable	Not Applicable	Not Applicable	
Serious Injury (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00	0% 0.00	
Loss of Life (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00	0% 0.00	
Post-event Tagging Flag:	NO	NO	NO	NO	
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00	0% 0.00	
Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.				
Date Created:	Not Given				Root Cost Multiplier: 1
Approved (YES / NO)?	By User				
Official (YES / NO) ?	By User				
Author:	Not Given				
Revisions:	None				

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3032.013d
Compressor - Capacity: Large non medical air supply - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragili
Costing is per unit.

Line 498

Construction Quality:
Seismic Installation Conditions:
Fragility Unit of Measure:
Demand Parameter (unit):
Number of Damage States:
Damage State:
Type of Damage State:
DS Hierarchy
Descriptions


Normal - Designed for seismic loads but no special seismic certification
Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints
EA 1
Peak Floor Acceleration g
2
DS1
Mutually Exclusive
MutEx(DS1,DS2)
Anchorage failure.

DS2
Mutually Exclusive
Anchorage failure & Equipment
damaged beyond repair.

Quantity Rounding
Round Qty?
Allow sum by floor or building?
Demand Location (floor above?)

YES
BLDG
No

Illustrations



D3032.011a-DS1-1.JPG

none

0.70

0.30

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User
User to Calculate
User to Calculate
By User
NO
NO
Average
Average
Superior
Superior
Repair anchorage and concrete pad and remount equipment.

By User
User to Calculate
User to Calculate
By User
NO
NO
Average
Average
Superior
Superior
Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau
(Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau
(Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties?
(Yes / No)

Casualty-affected Planar Area (sf)
per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

5.50E+02

8.50E+02

1.60E+03

P₁₀

P₅₀

P₉₀

7.21E+03

8.85E+03

1.23E+04

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

8.98E+02

LogNormal

1.00

5.00

9.35E+02

0.44

7.65E+02

0.44

9.22E+03

LogNormal

1.00

5.00

9.74E+03

0.22

7.97E+03

0.22

Each

Each

P₁₀

P₅₀

P₉₀

1.94E-01

3.00E-01

5.65E-01

P₁₀

P₅₀

P₉₀

2.54E+00

3.12E+00

4.35E+00

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.00E-01

LogNormal

1.00

5.00

3.30E-01

0.51

2.70E-01

0.51

3.12E+00

LogNormal

1.00

5.00

3.44E+00

0.33

2.81E+00

0.33

Each

Each

NO

Not Applicable

0%

0.00

NO

Not Applicable

0%

0.00

NO

0%

0.00

NO

0%

0.00

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3032.013e

Compressor - Capacity: Large non medical air supply - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragili

Line 499

Costing is per unit.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

EA 1

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

MutEx(DS1,DS2)

Equipment does not function but anchorage is OK. Motor is damaged.

Equipment does not function but anchorage is OK. Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

Allow sum by floor or building?


Demand Location (floor above?)

YES

BLDG

No

Illustrations



D3032.011a-DS1-1.JPG

none

Damage State Probability:

0.50

0.50

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.84

1.84

0.6

0.60

0.1

0.1

0.6

0.6

NO

NO

Average

Average

Superior

Superior

Repair motor.

Replace equipment.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.55E+03

3.00E+03

3.90E+03

6.66E+03

8.00E+03

1.07E+04

3.10E+03

LogNormal

1.00

5.00

1.00

5.00

3.30E+03

2.70E+03

8.80E+03

7.20E+03

0.17

0.17

0.19

0.19

Each

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.00E+00

3.53E+00

4.59E+00

7.84E-01

9.41E-01

1.26E+00

3.53E+00

LogNormal

1.00

5.00

1.00

5.00

3.88E+00

3.18E+00

1.88E+00

4.71E-01

0.30

0.30

0.32

0.32

Each

Each

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

NO

NO

0%

0.00

0%

0.00

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3032.013f

Compressor - Capacity: Large non medical air supply - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined ancho

Costing is per unit.

Line 500

Construction Quality:	Normal - Designed for seismic loads but no special seismic certification			
Seismic Installation Conditions:	Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	4			
Damage State:	DS1	DS2	DS3	DS4
Type of Damage State:	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive
DS Hierarchy	MutEx(DS1,DS2,DS3,DS4)			
Descriptions	Anchorage failure.	Anchorage failure & Equipment damaged beyond repair.	Motor damaged but anchorage is OK.	Equipment damaged beyond repair but anchorage is OK.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		BLDG
Demand Location (floor above?)		No

Illustrations



D3032.011a-DS1-1.JPG

none

none

none

Damage State Probability:	0.35	0.15	0.25	0.25
Fragility Parameters				
Median Demand, θ :	By User	By User	By User	By User
Data dispersion, β_d :	User to Calculate	User to Calculate	User to Calculate	User to Calculate
Uncertainty, β_u :	User to Calculate	User to Calculate	User to Calculate	User to Calculate
Total Dispersion, β_t :	By User	By User	By User	By User
Correlation (Yes / No)	NO			
Directionality (Yes / No)	NO			
Quality Ratings				
Data Quality	Average			
Data Relevance	Average			
Documentation Quality	Superior			
Rationality	Superior			
Consequence Functions				
Repair Description	Repair anchorage and concrete pad and remount equipment.	Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.	Repair Motor - Anchorage and Concrete do not require repair.	Replace and install equipment including new anchorage if anchorage is post-installed.

Long Lead Time (Yes / No) NO YES NO YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	5.50E+02	8.50E+02	1.60E+03	7.21E+03	8.85E+03	1.23E+04	2.55E+03	3.00E+03	3.90E+03	7.21E+03	8.85E+03	1.23E+04			
Best fit mean:	8.98E+02			9.22E+03			3.10E+03			9.22E+03					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00	1.00		5.00			
Average Repair Cost (Min Qty, Max Qty)	9.35E+02		7.65E+02	9.74E+03		7.97E+03	3.30E+03		2.70E+03	9.74E+03		7.97E+03			
CV or beta (Min Qty, Max Qty)	0.44		0.44	0.22		0.22	0.17		0.17	0.22		0.22			
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	6.47E-01	1.00E+00	1.88E+00	2.54E+00	3.12E+00	4.35E+00	3.00E+00	3.53E+00	4.59E+00	8.48E+00	1.04E+01	1.45E+01			
Best fit mean:	1.00E+00			3.12E+00			3.53E+00			1.04E+01					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00	1.00		5.00			
Average Repair Time (Min Qty, Max Qty)	1.10E+00		9.00E-01	4.16E+00		2.08E+00	3.88E+00		3.18E+00	1.15E+01		9.37E+00			
CV or beta (Min Qty, Max Qty)	0.51		0.51	0.33		0.33	0.30		0.30	0.33		0.33			
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00	0%		0.00			
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00	0%		0.00			
Post-event Tagging Flag:	NO			NO			NO			NO					
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	0%		0.00	0%		0.00	0%		0.00			
Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														
													Root Cost Multiplier:		1

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3032.013g

Compressor - Capacity: Small medical quality air supply - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fra

Costing is per unit.

Line 501

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

EA 1

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

MutEx(DS1,DS2)

Anchorage failure.

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

YES

BLDG

No

Illustrations



D3032.011a-DS1-1.JPG

none

0.30

Damage State Probability:

0.70

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User

User to Calculate

User to Calculate

By User

NO

NO

Average

Average

Superior

Superior

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau

(Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Each

P₁₀

P₅₀

P₉₀

2.50E+02

4.50E+02

9.50E+02

6.86E+03

8.65E+03

1.23E+04

8.89E+03

1.23E+04

1.00

5.00

1.00

5.00

4.95E+02

4.05E+02

9.52E+03

7.79E+03

0.55

0.55

0.24

0.24

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau

(Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Each

P₁₀

P₅₀

P₉₀

2.94E-01

5.29E-01

1.12E+00

8.07E-01

1.02E+00

1.45E+00

1.02E+00

1.45E+00

1.00

5.00

1.00

5.00

5.82E-01

4.76E-01

2.04E+00

5.09E-01

0.60

0.60

0.35

0.35

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

0%

0.00

0%

0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Not Given

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.		
Date Created:	Not Given	Root Cost Multiplier:	1
Approved (YES / NO)?	By User		
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	None		

[illegible]

None

FEMA P-58 Fragility Specification

NISTIR Classification D3041.001a
NISTIR Name HVAC Fan In Line Fan, Fan independently supported and vibration isolators, SDC A or B
Description Costing per 10 units

Line 507

Construction Quality:	Normal					Quantity Rounding		Round Qty?		NO		
Seismic Installation Conditions:	Normal - SDC A or B											
Fragility Unit of Measure:	EA 10					Allow sum by floor or building? NO						
Demand Parameter (unit):	Peak Floor Acceleration											Demand Location (floor above)? Yes
	g											
Number of Damage States:	2											
Damage State:	DS1					DS2						
Type of Damage State:	Sequential					Sequential						
DS Hierarchy	Seq(DS1,DS2)											
Descriptions	Bellows fails at fans.					Fan dislodges from isolators and drops.						

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations					
	none	none			
Damage State Probability:	1.00	1.00			

Fragility Parameters					
Median Demand, θ :	1.92	2.4			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.5	0.5			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Superior				
Documentation Quality	Marginal				
Rationality	Marginal				
Consequence Functions					
Repair Description	Replace failed bellows.		Replace fan, isolators and section of ducting to which fan is connected.		

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	5.00E+03	7.00E+03	1.15E+04	2.50E+04	2.70E+04	3.15E+04									
Best fit mean:	7.34E+03			2.77E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Cost (Min Qty, Max Qty)	7.70E+03		6.30E+03	2.97E+04		2.43E+04									
CV or beta (Min Qty, Max Qty)	0.34		0.34	0.09		0.09									
Quantity Unit:	10 Units			10 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.88E+00	8.24E+00	1.35E+01	8.82E+00	9.53E+00	1.11E+01									
Best fit mean:	8.24E+00			9.53E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Time (Min Qty, Max Qty)	9.06E+00		7.41E+00	1.27E+01		6.35E+00									
CV or beta (Min Qty, Max Qty)	0.42		0.42	0.27		0.27									
Quantity Unit:	10 Units			10 Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			10 SF											
Serious Injury (Median, Dispersion)	0%	0.00		10%	0.50										
Loss of Life (Median, Dispersion)	0%	0.00		5%	0.50										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										
Comments:	One failure is expected per 10 units.														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														
	Root Cost Multiplier: 10														

Root Cost Multiplier: 10

FEMA P-58 Fragility Specification

NISTIR Classification D3041.001b
NISTIR Name HVAC Fan In Line Fan, Fan independently supported and vibration isolators, SDC C
Description Costing per 10 units

Line 508

Construction Quality:	Normal				<div>Quantity Rounding</div> <div>Round Qty?</div> <div>NO</div> <div>Allow sum by floor or building?</div> <div>NO</div> <div>Demand Location (floor above?)</div> <div>Yes</div>	
Seismic Installation Conditions:	Normal - SDC C					
Fragility Unit of Measure:	EA 10					
Demand Parameter (unit):	Peak Floor Acceleration					g
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Bellows fails at fans.		Fan dislodges from isolators and drops.			

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations					
	none	none			
Damage State Probability:	1.00	1.00			

Fragility Parameters					
Median Demand, θ :	1.92	2.4			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.5	0.5			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Superior				
Documentation Quality	Marginal				
Rationality	Marginal				
Consequence Functions					
Repair Description	Replace failed bellows.		Replace fan, isolators and section of ducting to which fan is connected.		

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	5.00E+03	7.00E+03	1.15E+04	2.50E+04	2.70E+04	3.15E+04									
Best fit mean:	7.34E+03			2.77E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Cost (Min Qty, Max Qty)	7.70E+03		6.30E+03	2.97E+04		2.43E+04									
CV or beta (Min Qty, Max Qty)	0.34		0.34	0.09		0.09									
Quantity Unit:	10 Units			10 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.88E+00	8.24E+00	1.35E+01	8.82E+00	9.53E+00	1.11E+01									
Best fit mean:	8.24E+00			9.53E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Time (Min Qty, Max Qty)	9.06E+00		7.41E+00	1.27E+01		6.35E+00									
CV or beta (Min Qty, Max Qty)	0.42		0.42	0.27		0.27									
Quantity Unit:	10 Units			10 Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			10 SF											
Serious Injury (Median, Dispersion)	0%	0.00		10%	0.50										
Loss of Life (Median, Dispersion)	0%	0.00		5%	0.50										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										
Comments:	One failure is expected per 10 units.														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														
	Root Cost Multiplier: 10														

Root Cost Multiplier: 10

FEMA P-58 Fragility Specification

NISTIR Classification D3041.001d
NISTIR Name HVAC Fan In Line Fan, Fan independently supported and vibration isolators, SDC D, E, F (OSHDP or sim)
Description Costing per 10 units

Line 510

Construction Quality: Special Regulation (e.g. OSHPD) for HVAC installations
Seismic Installation Conditions: Special Regulation (e.g. OSHPD) for HVAC installations - SDC D, E or F (high seismic design)
Fragility Unit of Measure: EA 10
Demand Parameter (unit): Peak Floor Acceleration g
Number of Damage States: 2
Damage State: DS1 Sequential
Type of Damage State: Sequential
DS Hierarchy Seq(DS1,DS2)
Descriptions Bellows fails at fans. Fan dislodges from isolators and drops.

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations

Damage State Probability:	none	none			
	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	2.25	2.6			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Superior				
Documentation Quality	Marginal				
Rationality	Marginal				
Consequence Functions					
Repair Description	Replace failed bellows.	Replace fan, isolators and section of ducting to which fan is connected.			

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	5.00E+03	7.00E+03	1.15E+04	2.50E+04	2.70E+04	3.15E+04									
Best fit mean:	7.34E+03			2.77E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Cost (Min Qty, Max Qty)	7.70E+03		6.30E+03	2.97E+04		2.43E+04									
CV or beta (Min Qty, Max Qty)	0.34		0.34	0.09		0.09									
Quantity Unit:	10 Units			10 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.88E+00	8.24E+00	1.35E+01	8.82E+00	9.53E+00	1.11E+01									
Best fit mean:	8.24E+00			9.53E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Time (Min Qty, Max Qty)	9.06E+00		7.41E+00	1.27E+01		6.35E+00									
CV or beta (Min Qty, Max Qty)	0.42		0.42	0.27		0.27									
Quantity Unit:	10 Units			10 Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:															
Serious Injury (Median, Dispersion)	0%	0.00		10%	0.50										
Loss of Life (Median, Dispersion)	0%	0.00		5%	0.50										
Post-event Tagging Flag:															
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										
Comments:	One failure is expected per 10 units.														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														

Root Cost Multiplier: 10

FEMA P-58 Fragility Specification

NISTIR Classification D3041.002a
NISTIR Name HVAC Fan In Line Fan, Fan independently supported but not on vibration isolators, SDC A or B
Description Costing per 10 units

Line 511

Construction Quality: Normal

Seismic Installation Conditions: Normal - SDC A or B

Fragility Unit of Measure: EA 10

Demand Parameter (unit): Peak Floor Acceleration g

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1)

Descriptions: Bellows fails at fans.

Quantity Rounding: Round Qty? NO

Allow sum by floor or building? NO

Demand Location (floor above?) Yes

Illustrations					
	none				

Damage State Probability: 1.00

Fragility Parameters

Median Demand, θ : 1.9

Data dispersion, β_d : Not Specified

Uncertainty, β_u : Not Specified

Total Dispersion, β : 0.4

Correlation (Yes / No): NO

Directionality (Yes / No): NO

Quality Ratings

Data Quality: Marginal

Data Relevance: Superior

Documentation Quality: Marginal

Rationality: Marginal

Consequence Functions

Repair Description: Replace failed bellows.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	5.00E+03	7.00E+03	1.15E+04												
Best fit mean:	7.34E+03														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Cost (Min Qty, Max Qty)	7.70E+03		6.30E+03												
CV or beta (Min Qty, Max Qty)	0.34		0.34												
Quantity Unit:	10 Units														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.88E+00	8.24E+00	1.35E+01												
Best fit mean:	8.24E+00														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Time (Min Qty, Max Qty)	9.06E+00		7.41E+00												
CV or beta (Min Qty, Max Qty)	0.42		0.42												
Quantity Unit:	10 Units														
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	One failure is expected per 10 units.														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														

Root Cost Multiplier: 10

FEMA P-58 Fragility Specification

NISTIR Classification D3041.002b
NISTIR Name HVAC Fan In Line Fan, Fan independently supported but not on vibration isolators, SDC C
Description Costing per 10 units

Line 512

Construction Quality: Normal

Seismic Installation Conditions: Normal - SDC C

Fragility Unit of Measure: EA 10

Demand Parameter (unit): Peak Floor Acceleration g

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1)

Descriptions: Bellows fails at fans.

Quantity Rounding: Round Qty? NO

Allow sum by floor or building? NO

Demand Location (floor above?) Yes

Illustrations					
	none				

Damage State Probability: 1.00

Fragility Parameters

Median Demand, θ : 1.9

Data dispersion, β_d : Not Specified

Uncertainty, β_u : Not Specified

Total Dispersion, β : 0.4

Correlation (Yes / No): NO

Directionality (Yes / No): NO

Quality Ratings

Data Quality: Marginal

Data Relevance: Superior

Documentation Quality: Marginal

Rationality: Marginal

Consequence Functions

Repair Description: Replace failed bellows.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	5.00E+03	7.00E+03	1.15E+04												
Best fit mean:	7.34E+03														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Cost (Min Qty, Max Qty)	7.70E+03		6.30E+03												
CV or beta (Min Qty, Max Qty)	0.34		0.34												
Quantity Unit:	10 Units														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.88E+00	8.24E+00	1.35E+01												
Best fit mean:	8.24E+00														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Time (Min Qty, Max Qty)	9.06E+00		7.41E+00												
CV or beta (Min Qty, Max Qty)	0.42		0.42												
Quantity Unit:	10 Units														
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	One failure is expected per 10 units.														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														

Root Cost Multiplier: 10

FEMA P-58 Fragility Specification

NISTIR Classification D3041.002c
NISTIR Name HVAC Fan In Line Fan, Fan independently supported but not on vibration isolators, SDC D, E, F
Description Costing per 10 units

Line 513

Construction Quality: Normal

Seismic Installation Conditions: Normal - SDC D, E or F

Fragility Unit of Measure: EA 10

Demand Parameter (unit): Peak Floor Acceleration g

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1)

Descriptions: Bellows fails at fans.

Quantity Rounding: Round Qty? NO

Allow sum by floor or building? NO

Demand Location (floor above?) Yes

Illustrations

none

1.00

Fragility Parameters

Median Demand, θ : 2.25

Data dispersion, β_d : Not Specified

Uncertainty, β_u : Not Specified

Total Dispersion, β : 0.4

Correlation (Yes / No): NO

Directionality (Yes / No): NO

Quality Ratings

Data Quality: Marginal

Data Relevance: Superior

Documentation Quality: Marginal

Rationality: Marginal

Consequence Functions

Repair Description: Replace failed bellows.

Long Lead Time (Yes / No) NO

Repair Costs:

Repair Cost by Damage State: 5.00E+03 7.00E+03 1.15E+04

Best fit mean: 7.34E+03

Best Fit Distribution: LogNormal

Quantity Plateau (Min Qty, Max Qty): 1.00 5.00

Average Repair Cost (Min Qty, Max Qty): 7.70E+03 6.30E+03

CV or beta (Min Qty, Max Qty): 0.34 0.34

Quantity Unit: 10 Units

Repair Time:

Repair Time by Damage State: 5.88E+00 8.24E+00 1.35E+01

Best fit mean: 8.24E+00

Best Fit Distribution: LogNormal

Quantity Plateau (Min Qty, Max Qty): 1.00 5.00

Average Repair Time (Min Qty, Max Qty): 9.06E+00 7.41E+00

CV or beta (Min Qty, Max Qty): 0.42 0.42

Quantity Unit: 10 Units

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No): NO

Casualty-affected Planar Area (sf) per Normative Unit: Not Applicable

Serious Injury (Median, Dispersion): 0% 0.00

Loss of Life (Median, Dispersion): 0% 0.00

Post-event Tagging Flag: NO

Unsafe Placard Trigger (Median, Dispersion): 0% 0.00

Comments: One failure is expected per 10 units.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: None

Root Cost Multiplier: 10

FEMA P-58 Fragility Specification

NISTIR ClassificationD3041.002d

NISTIR NameHVAC Fan In Line Fan, Fan independently supported but not on vibration isolators, SDC D, E, F (OSHDP or sim)

DescriptionCosting per 10 units

Line 514

Construction Quality:Special Regulation (e.g. OSHPD) for HVAC installations

Seismic Installation Conditions:Special Regulation (e.g. OSHPD) for HVAC installations - SDC D, E or F (high seismic design)

Fragment Unit of Measure:EA 10

Demand Parameter (unit):Peak Floor Accelerationg

Number of Damage States:1

Damage State:DS1

Type of Damage State:Sequential

DS HierarchySeq(DS1)

DescriptionsBellows fails at fans.

Quantity RoundingRound Qty?NO

Allow sum by floor or building?NO

Demand Location (floor above?)Yes

Illustrations

none

Damage State Probability:1.00

Fragility Parameters

Median Demand, θ :2.25

Data dispersion, β_d :Not Specified

Uncertainty, β_u :Not Specified

Total Dispersion, β :0.4

Correlation (Yes / No)NO

Directionality (Yes / No)NO

Quality Ratings

Data QualityMarginal

Data RelevanceSuperior

Documentation QualityMarginal

RationalityMarginal

Consequence Functions

Repair DescriptionReplace failed bellows.

Long Lead Time (Yes / No)NO

Repair Costs:

Repair Cost by Damage State:

P₁₀5.00E+03P₅₀7.00E+03P₉₀1.15E+04

Best fit mean:

7.34E+03

Best Fit Distribution:LogNormal

Quantity Plateau (Min Qty, Max Qty)

1.005.00

Average Repair Cost (Min Qty, Max Qty)

7.70E+036.30E+03

CV or beta (Min Qty, Max Qty)

0.340.34

Quantity Unit:10 Units

Repair Time:

Repair Time by Damage State:

P₁₀5.88E+00P₅₀8.24E+00P₉₀1.35E+01

Best fit mean:

8.24E+00

Best Fit Distribution:LogNormal

Quantity Plateau (Min Qty, Max Qty)

1.005.00

Average Repair Time (Min Qty, Max Qty)

9.06E+007.41E+00

CV or beta (Min Qty, Max Qty)

0.420.42

Quantity Unit:10 Units

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)NO

Casualty-affected Planar Area (sf) per Normative Unit:Not Applicable

Serious Injury (Median, Dispersion)

0%0.00

Loss of Life (Median, Dispersion)

0%0.00

Post-event Tagging Flag:NO

Unsafe Placard Trigger (Median, Dispersion)

0%0.00

Comments:One failure is expected per 10 units.

Date Created:Not Given

Approved (YES / NO)?By User

Official (YES / NO) ?By User

Author:Not Given

Revisions:None

Root Cost Multiplier:10

FEMA P-58 Fragility Specification

NISTIR Classification D3041.011a
NISTIR Name HVAC Galvanized Sheet Metal Ducting less than 6 sq. ft in cross sectional area, SDC A or B
Description Costing based upon 1000 ft segments of duct

Line 515

Construction Quality:	Normal					<div>Quantity RoundingRound Qty?NO Allow sum by floor or building?NO Demand Location (floor above?)Yes</div>
Seismic Installation Conditions:	Normal - SDC A or B					
Fragility Unit of Measure:	LF 1000					
Demand Parameter (unit):	Peak Floor Accelerationg					
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Individual supports fail and duct sags - 1 failed support per 1000 feet of ducting.					Several adjacent supports fail and sections of ducting fail - 60 feet of ducting fail and fall per 1000 foot of ducting.

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations					
	none	none			
Damage State Probability:	1.00	1.00			

Fragility Parameters					
Median Demand, θ :	1.5	2.25			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Superior				
Documentation Quality	Marginal				
Rationality	Marginal				
Consequence Functions					
Repair Description	Replace failed supports and repair ducting in vicinity of failed supports. Replace sections of failed ducting and supports.				

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	4.50E+02	6.50E+02	1.10E+03	5.75E+03	6.35E+03	7.40E+03									
Best fit mean:	6.81E+02			6.46E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Cost (Min Qty, Max Qty)	7.15E+02		5.85E+02	6.99E+03		5.72E+03									
CV or beta (Min Qty, Max Qty)	0.37		0.37	0.10		0.10									
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.29E-01	7.65E-01	1.29E+00	2.03E+00	2.24E+00	2.61E+00									
Best fit mean:	7.65E-01			2.24E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Time (Min Qty, Max Qty)	8.41E-01		6.88E-01	2.99E+00		1.49E+00									
CV or beta (Min Qty, Max Qty)	0.44		0.44	0.27		0.27									
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			15 SF											
Serious Injury (Median, Dispersion)	0%	0.00		5%	0.50										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														
	Root Cost Multiplier: 1														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification D3041.011b
NISTIR Name HVAC Galvanized Sheet Metal Ducting less than 6 sq. ft in cross sectional area, SDC C
Description Costing based upon 1000 ft segments of duct

Line 516

Construction Quality:	Normal				
Seismic Installation Conditions:	Normal - SDC C				
Fragility Unit of Measure:	LF 1000				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	2				
Damage State:	DS1	DS2			
Type of Damage State:	Sequential Sequential				
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Individual supports fail and duct sags - 1 Several adjacent supports fail and sections of ducting fail - 60 feet of failed support per 1000 feet of ducting. ducting fail and fall per 1000 foot of ducting.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations					
	none	none			
Damage State Probability:	1.00	1.00			

Fragility Parameters					
Median Demand, θ :	1.5	2.25			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Superior				
Documentation Quality	Marginal				
Rationality	Marginal				
Consequence Functions					
Repair Description	Replace failed supports and repair ducting in vicinity of failed supports. Replace sections of failed ducting and supports.				

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	4.50E+02	6.50E+02	1.10E+03	5.75E+03	6.35E+03	7.40E+03									
Best fit mean:	6.81E+02			6.46E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Cost (Min Qty, Max Qty)	7.15E+02		5.85E+02	6.99E+03		5.72E+03									
CV or beta (Min Qty, Max Qty)	0.37		0.37	0.10		0.10									
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.29E-01	7.65E-01	1.29E+00	2.03E+00	2.24E+00	2.61E+00									
Best fit mean:	7.65E-01			2.24E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Time (Min Qty, Max Qty)	8.41E-01		6.88E-01	2.99E+00		1.49E+00									
CV or beta (Min Qty, Max Qty)	0.44		0.44	0.27		0.27									
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			15 SF											
Serious Injury (Median, Dispersion)	0%	0.00		5%	0.50										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														
	Root Cost Multiplier: 1														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification D3041.011c
NISTIR Name HVAC Galvanized Sheet Metal Ducting less than 6 sq. ft in cross sectional area, SDC D, E, or F
Description Costing based upon 1000 ft segments of duct

Line 517

Construction Quality:	Normal				
Seismic Installation Conditions:	Normal - SDC D, E or F				
Fragility Unit of Measure:	LF 1000				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	2				
Damage State:	DS1	DS2			
Type of Damage State:	Sequential Sequential				
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Individual supports fail and duct sags - 1 Several adjacent supports fail and sections of ducting fail - 60 feet of failed support per 1000 feet of ducting. ducting fail and fall per 1000 foot of ducting.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations					
	none	none			
	1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	1.5	2.25			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β_t :	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Superior				
Documentation Quality	Marginal				
Rationality	Marginal				
Consequence Functions					
Repair Description	Replace failed supports and repair ducting in vicinity of failed supports. Replace sections of failed ducting and supports.				

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	4.50E+02	6.50E+02	1.10E+03	5.75E+03	6.35E+03	7.40E+03									
Best fit mean:	6.81E+02			6.46E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Cost (Min Qty, Max Qty)	7.15E+02		5.85E+02	6.99E+03		5.72E+03									
CV or beta (Min Qty, Max Qty)	0.37		0.37	0.10		0.10									
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.29E-01	7.65E-01	1.29E+00	2.03E+00	2.24E+00	2.61E+00									
Best fit mean:	7.65E-01			2.24E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Time (Min Qty, Max Qty)	8.41E-01		6.88E-01	2.99E+00		1.49E+00									
CV or beta (Min Qty, Max Qty)	0.44		0.44	0.27		0.27									
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			15 SF											
Serious Injury (Median, Dispersion)	0%	0.00		5%	0.50										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														
	Root Cost Multiplier: 1														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR ClassificationD3041.011d

NISTIR NameHVAC Galvanized Sheet Metal Ducting less than 6 sq. ft in cross sectional area, SDC D, E, or F (OSHDP or sim)

DescriptionCosting based upon 1000 ft segments of duct

Line 518

Construction Quality:	Special Regulation (e.g. OSHPD) for HVAC ducting installation				
Seismic Installation Conditions:	Special Regulation (e.g. OSHPD) for HVAC ducting installation - SDC D, E or F (high seismic design)				
Fragility Unit of Measure:	LF 1000				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	2				
Damage State:	DS1	DS2			
Type of Damage State:	Sequential				
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Individual supports fail and duct sags - 1 Several adjacent supports fail and sections of ducting fail - 60 feet of failed support per 1000 feet of ducting. ducting fail and fall per 1000 foot of ducting.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations					
	none	none			
Damage State Probability:	1.00	1.00			

Fragility Parameters					
Median Demand, θ :	1.5	2.25			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Superior				
Documentation Quality	Marginal				
Rationality	Marginal				
Consequence Functions					
Repair Description	Replace failed supports and repair ducting in vicinity of failed supports. Replace sections of failed ducting and supports.				

Long Lead Time (Yes / No)NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	4.50E+02	6.50E+02	1.10E+03	5.75E+03	6.35E+03	7.40E+03									
Best fit mean:	6.81E+02			6.46E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Cost (Min Qty, Max Qty)	7.15E+02		5.85E+02	6.99E+03		5.72E+03									
CV or beta (Min Qty, Max Qty)	0.37		0.37	0.10		0.10									
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.29E-01	7.65E-01	1.29E+00	2.03E+00	2.24E+00	2.61E+00									
Best fit mean:	7.65E-01			2.24E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Time (Min Qty, Max Qty)	8.41E-01		6.88E-01	2.99E+00		1.49E+00									
CV or beta (Min Qty, Max Qty)	0.44		0.44	0.27		0.27									
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			15 SF											
Serious Injury (Median, Dispersion)	0%	0.00		5%	0.50										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														
	Root Cost Multiplier: 1														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification D3041.012a
NISTIR Name HVAC Galvanized Sheet Metal Ducting - 6 sq. ft cross sectional area or greater, SDC A or B
Description Costing based upon 1000 ft segments of duct

Line 519

Construction Quality:	Normal					<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above?)Yes</div>
Seismic Installation Conditions:	Normal - SDC A or B					
Fragility Unit of Measure:	LF 1000					
Demand Parameter (unit):	Peak Floor Accelerationg					
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Individual supports fail and duct sags - 1 failed support per 1000 feet of ducting.					Several adjacent supports fail and sections of ducting fail - 60 feet of ducting fail and fall per 1000 foot of ducting.

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations					
	none	none			
Damage State Probability:	1.00	1.00			

Fragility Parameters					
Median Demand, θ :	1.5	2.25			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Superior				
Documentation Quality	Marginal				
Rationality	Marginal				
Consequence Functions					
Repair Description	Replace failed supports and repair ducting in vicinity of failed supports. Replace sections of failed ducting and supports.				

Long Lead Time (Yes / No) NO NO

Repair Costs:		P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:		7.50E+02	9.50E+02	1.40E+03	7.25E+03	7.95E+03	8.90E+03									
Best fit mean:		9.96E+02			8.00E+03											
Best Fit Distribution:		LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)		1.00		5.00	1.00		5.00									
Average Repair Cost (Min Qty, Max Qty)		1.05E+03		8.55E+02	8.75E+03		7.16E+03									
CV or beta (Min Qty, Max Qty)		0.26		0.26	0.08		0.08									
Quantity Unit:		Each (1000 ft duct)			Each (1000 ft duct)											
Repair Time:		P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:		8.82E-01	1.12E+00	1.65E+00	2.56E+00	2.81E+00	3.14E+00									
Best fit mean:		1.12E+00			2.81E+00											
Best Fit Distribution:		LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)		1.00		5.00	1.00		5.00									
Average Repair Time (Min Qty, Max Qty)		1.23E+00		1.01E+00	3.74E+00		1.87E+00									
CV or beta (Min Qty, Max Qty)		0.36		0.36	0.26		0.26									
Quantity Unit:		Each (1000 ft duct)			Each (1000 ft duct)											
LifeSafety Hazard:																
Potential non-collapse casualties? (Yes / No)		NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:		Not Applicable			50 SF											
Serious Injury (Median, Dispersion)		0%	0.00		10%	0.50										
Loss of Life (Median, Dispersion)		0%	0.00		0%	0.00										
Post-event Tagging Flag:		NO			NO											
Unsafe Placard Trigger (Median, Dispersion)		0%	0.00		0%	0.00										
Comments:		None														
Date Created:		Not Given														
Approved (YES / NO)?		By User														
Official (YES / NO) ?		By User														
Author:		Not Given														
Revisions:		None														
		Root Cost Multiplier: 1														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification D3041.012b
NISTIR Name HVAC Galvanized Sheet Metal Ducting - 6 sq. ft cross sectional area or greater, SDC C
Description Costing based upon 1000 ft segments of duct

Line 520

Construction Quality:	Normal					<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above?)Yes</div>
Seismic Installation Conditions:	Normal - SDC C					
Fragility Unit of Measure:	LF 1000					
Demand Parameter (unit):	Peak Floor Accelerationg					
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Individual supports fail and duct sags - 1 failed support per 1000 feet of ducting.					Several adjacent supports fail and sections of ducting fail - 60 feet of ducting fail and fall per 1000 foot of ducting.

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations					
	none	none			
Damage State Probability:	1.00	1.00			

Fragility Parameters					
Median Demand, θ :	1.5	2.25			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Superior				
Documentation Quality	Marginal				
Rationality	Marginal				
Consequence Functions					
Repair Description	Replace failed supports and repair ducting in vicinity of failed supports. Replace sections of failed ducting and supports.				

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	7.50E+02	9.50E+02	1.40E+03	7.25E+03	7.95E+03	8.90E+03									
Best fit mean:	9.96E+02			8.00E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Cost (Min Qty, Max Qty)	1.05E+03		8.55E+02	8.75E+03		7.16E+03									
CV or beta (Min Qty, Max Qty)	0.26		0.26	0.08		0.08									
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.82E-01	1.12E+00	1.65E+00	2.56E+00	2.81E+00	3.14E+00									
Best fit mean:	1.12E+00			2.81E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Time (Min Qty, Max Qty)	1.23E+00		1.01E+00	3.74E+00		1.87E+00									
CV or beta (Min Qty, Max Qty)	0.36		0.36	0.26		0.26									
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			50 SF											
Serious Injury (Median, Dispersion)	0%	0.00		10%	0.50										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														
	Root Cost Multiplier: 1														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification D3041.012c
NISTIR Name HVAC Galvanized Sheet Metal Ducting - 6 sq. ft cross sectional area or greater, SDC D, E, or F
Description Costing based upon 1000 ft segments of duct

Line 521

Construction Quality:	Normal					<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above)?Yes</div>
Seismic Installation Conditions:	Normal - SDC D, E or F					
Fragility Unit of Measure:	LF 1000					
Demand Parameter (unit):	Peak Floor Accelerationg					
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Individual supports fail and duct sags - 1 failed support per 1000 feet of ducting.					Several adjacent supports fail and sections of ducting fail - 60 feet of ducting fail and fall per 1000 foot of ducting.

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations					
	none	none			
Damage State Probability:	1.00	1.00			

Fragility Parameters					
Median Demand, θ :	3.75	4.5			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Superior				
Documentation Quality	Marginal				
Rationality	Marginal				
Consequence Functions					
Repair Description	Replace failed supports and repair ducting in vicinity of failed supports. Replace sections of failed ducting and supports.				

Long Lead Time (Yes / No) NO NO

Repair Costs:		P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:		7.50E+02	9.50E+02	1.40E+03	7.25E+03	7.95E+03	8.90E+03									
Best fit mean:		9.96E+02			8.00E+03											
Best Fit Distribution:		LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)		1.00		5.00	1.00		5.00									
Average Repair Cost (Min Qty, Max Qty)		1.05E+03		8.55E+02	8.75E+03		7.16E+03									
CV or beta (Min Qty, Max Qty)		0.26		0.26	0.08		0.08									
Quantity Unit:		Each (1000 ft duct)			Each (1000 ft duct)											
Repair Time:		P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:		8.82E-01	1.12E+00	1.65E+00	2.56E+00	2.81E+00	3.14E+00									
Best fit mean:		1.12E+00			2.81E+00											
Best Fit Distribution:		LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)		1.00		5.00	1.00		5.00									
Average Repair Time (Min Qty, Max Qty)		1.23E+00		1.01E+00	3.74E+00		1.87E+00									
CV or beta (Min Qty, Max Qty)		0.36		0.36	0.26		0.26									
Quantity Unit:		Each (1000 ft duct)			Each (1000 ft duct)											
LifeSafety Hazard:																
Potential non-collapse casualties? (Yes / No)		NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:		Not Applicable			50 SF											
Serious Injury (Median, Dispersion)		0%	0.00		10%	0.50										
Loss of Life (Median, Dispersion)		0%	0.00		0%	0.00										
Post-event Tagging Flag:		NO			NO											
Unsafe Placard Trigger (Median, Dispersion)		0%	0.00		0%	0.00										
Comments:		None														
Date Created:		Not Given														
Approved (YES / NO)?		By User														
Official (YES / NO) ?		By User														
Author:		Not Given														
Revisions:		None														
		Root Cost Multiplier: 1														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification D3041.012d
NISTIR Name HVAC Galvanized Sheet Metal Ducting - 6 sq. ft cross sectional area or greater, SDC D, E, or F (OSHDP or sim)
Description Costing based upon 1000 ft segments of duct

Line 522

Construction Quality:	Special Regulation (e.g. OSHPD) for HVAC ducting installation				
Seismic Installation Conditions:	Special Regulation (e.g. OSHPD) for HVAC ducting installation - SDC D, E or F (high seismic design)				
Fragility Unit of Measure:	LF 1000				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	2				
Damage State:	DS1	DS2			
Type of Damage State:	Sequential Sequential				
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Individual supports fail and duct sags - 1 Several adjacent supports fail and sections of ducting fail - 60 feet of failed support per 1000 feet of ducting. ducting fail and fall per 1000 foot of ducting.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations					
	none	none			
Damage State Probability:	1.00	1.00			

Fragility Parameters					
Median Demand, θ :	3.75	4.5			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Superior				
Documentation Quality	Marginal				
Rationality	Marginal				
Consequence Functions					
Repair Description	Replace failed supports and repair ducting in vicinity of failed supports. Replace sections of failed ducting and supports.				

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	7.50E+02	9.50E+02	1.40E+03	7.25E+03	7.95E+03	8.90E+03									
Best fit mean:	9.96E+02			8.00E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Cost (Min Qty, Max Qty)	1.05E+03		8.55E+02	8.75E+03		7.16E+03									
CV or beta (Min Qty, Max Qty)	0.26		0.26	0.08		0.08									
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	8.82E-01	1.12E+00	1.65E+00	2.56E+00	2.81E+00	3.14E+00									
Best fit mean:	1.12E+00			2.81E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Time (Min Qty, Max Qty)	1.23E+00		1.01E+00	3.74E+00		1.87E+00									
CV or beta (Min Qty, Max Qty)	0.36		0.36	0.26		0.26									
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			50 SF											
Serious Injury (Median, Dispersion)	0%	0.00		10%	0.50										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														
	Root Cost Multiplier: 1														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification D3041.021a
NISTIR Name HVAC Stainless Steel Ducting less than 6 sq. ft in cross sectional area, SDC A or B
Description Costing based upon 1000 ft segments of duct

Line 523

Construction Quality:	Normal					<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above?)Yes</div>
Seismic Installation Conditions:	Normal - SDC A or B					
Fragility Unit of Measure:	LF 1000					
Demand Parameter (unit):	Peak Floor Accelerationg					
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Individual supports fail and duct sags - 1 failed support per 1000 feet of ducting. Several adjacent supports fail and sections of ducting fail - 60 feet of ducting fail and fall per 1000 foot of ducting.					

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations					
	none	none			
	1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	1.5	2.25			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Superior				
Documentation Quality	Marginal				
Rationality	Marginal				
Consequence Functions					
Repair Description	Replace failed supports and repair ducting in vicinity of failed supports. Replace sections of failed ducting and supports.				

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.05E+03	1.25E+03	1.70E+03	1.28E+04	1.60E+04	2.04E+04									
Best fit mean:	1.31E+03			1.61E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Cost (Min Qty, Max Qty)	1.38E+03		1.13E+03	1.75E+04		1.44E+04									
CV or beta (Min Qty, Max Qty)	0.20		0.20	0.18		0.18									
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.24E+00	1.47E+00	2.00E+00	4.50E+00	5.63E+00	7.20E+00									
Best fit mean:	1.47E+00			5.63E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Time (Min Qty, Max Qty)	1.62E+00		1.32E+00	7.51E+00		3.75E+00									
CV or beta (Min Qty, Max Qty)	0.32		0.32	0.31		0.31									
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			15 SF											
Serious Injury (Median, Dispersion)	0%	0.00		5%	0.50										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														
	Root Cost Multiplier: 1														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification D3041.021b
NISTIR Name HVAC Stainless Steel Ducting less than 6 sq. ft in cross sectional area, SDC C
Description Costing based upon 1000 ft segments of duct

Line 524

Construction Quality:	Normal					<div>Quantity RoundingRound Qty?NO Allow sum by floor or building?NO Demand Location (floor above?)Yes</div>
Seismic Installation Conditions:	Normal - SDC C					
Fragility Unit of Measure:	LF 1000					
Demand Parameter (unit):	Peak Floor Accelerationg					
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Individual supports fail and duct sags - 1 failed support per 1000 feet of ducting.					Several adjacent supports fail and sections of ducting fail - 60 feet of ducting fail and fall per 1000 foot of ducting.

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations					
	none	none			
	1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	1.5	2.25			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Superior				
Documentation Quality	Marginal				
Rationality	Marginal				
Consequence Functions					
Repair Description	Replace failed supports and repair ducting in vicinity of failed supports. Replace sections of failed ducting and supports.				

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀			
Repair Cost by Damage State:	1.05E+03	1.25E+03	1.70E+03	1.28E+04	1.60E+04	2.04E+04												
Best fit mean:	1.31E+03			1.61E+04														
Best Fit Distribution:	LogNormal			LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00												
Average Repair Cost (Min Qty, Max Qty)	1.38E+03		1.13E+03	1.75E+04		1.44E+04												
CV or beta (Min Qty, Max Qty)	0.20		0.20	0.18		0.18												
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀			
Repair Time by Damage State:	1.24E+00	1.47E+00	2.00E+00	4.50E+00	5.63E+00	7.20E+00												
Best fit mean:	1.47E+00			5.63E+00														
Best Fit Distribution:	LogNormal			LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00												
Average Repair Time (Min Qty, Max Qty)	1.62E+00		1.32E+00	7.51E+00		3.75E+00												
CV or beta (Min Qty, Max Qty)	0.32		0.32	0.31		0.31												
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)														
LifeSafety Hazard:																		
Potential non-collapse casualties? (Yes / No)	NO						YES											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable						15 SF											
Serious Injury (Median, Dispersion)	0%		0.00	5%		0.50												
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00												
Post-event Tagging Flag:	NO						NO											
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	0%		0.00												
Comments:	None																	
Date Created:	Not Given																	
Approved (YES / NO)?	By User																	
Official (YES / NO) ?	By User																	
Author:	Not Given																	
Revisions:	None																	
	Root Cost Multiplier: 1																	

Root Cost Multiplier: 1

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification D3041.021d
NISTIR Name HVAC Stainless Steel Ducting less than 6 sq. ft in cross sectional area, SDC D, E, or F (OSHDP or sim)
Description Costing based upon 1000 ft segments of duct

Line 526

Construction Quality: Special Regulation (e.g. OSHPD) for HVAC ducting installation
Seismic Installation Conditions: Special Regulation (e.g. OSHPD) for HVAC ducting installation - SDC D, E or F (high seismic design)

Fragility Unit of Measure: LF 1000
Demand Parameter (unit): Peak Floor Acceleration g
Number of Damage States: 2

Quantity Rounding Round Qty? NO
Allow sum by floor or building? NO
Demand Location (floor above?) Yes

Damage State:	DS1	DS2			
Type of Damage State:	Sequential				
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Individual supports fail and duct sags - 1 Several adjacent supports fail and sections of ducting fail - 60 feet of failed support per 1000 feet of ducting. ducting fail and fall per 1000 foot of ducting.				

Illustrations

none	none				
1.00	1.00				

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	1.5	2.25			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Superior				
Documentation Quality	Marginal				
Rationality	Marginal				
Consequence Functions					
Repair Description	Replace failed supports and repair ducting in vicinity of failed supports. Replace sections of failed ducting and supports.				

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.05E+03	1.25E+03	1.70E+03	1.28E+04	1.60E+04	2.04E+04									
Best fit mean:	1.31E+03			1.61E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Cost (Min Qty, Max Qty)	1.38E+03		1.13E+03	1.75E+04		1.44E+04									
CV or beta (Min Qty, Max Qty)	0.20		0.20	0.18		0.18									
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.16E+00	1.38E+00	1.88E+00	1.41E+01	1.76E+01	2.25E+01									
Best fit mean:	1.38E+00			1.76E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Time (Min Qty, Max Qty)	1.52E+00		1.24E+00	1.94E+01		1.58E+01									
CV or beta (Min Qty, Max Qty)	0.32		0.32	0.31		0.31									
Quantity Unit:	Each (1000 ft duct)			Each (1000 ft duct)											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			15 SF											
Serious Injury (Median, Dispersion)	0%	0.00		5%	0.50										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														
							Root Cost Multiplier: 1								

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification D3041.022a
NISTIR Name HVAC Stainless Steel Ducting - 6 sq. ft cross sectional area or greater, SDC A or B
Description Costing based upon 1000 ft segments of duct

Line 527

Construction Quality:	Normal					<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above?) Yes</div>
Seismic Installation Conditions:	Normal - SDC A or B					
Fragility Unit of Measure:	LF 1000					
Demand Parameter (unit):	Peak Floor Accelerationg					
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Individual supports fail and duct sags - 1 failed support per 1000 feet of ducting. Several adjacent supports fail and sections of ducting fail - 60 feet of ducting fail and fall per 1000 foot of ducting.					

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations					
	none	none			
	1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	1.5	2.25			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Superior				
Documentation Quality	Marginal				
Rationality	Marginal				
Consequence Functions					
Repair Description	Replace failed supports and repair ducting in vicinity of failed supports. Replace sections of failed ducting and supports.				

Long Lead Time (Yes / No) NO NO

Repair Costs:		P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:		1.75E+03	1.95E+03	2.40E+03	1.93E+04	2.15E+04	2.69E+04									
Best fit mean:		2.02E+03			2.23E+04											
Best Fit Distribution:		LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)		1.00		5.00	1.00		5.00									
Average Repair Cost (Min Qty, Max Qty)		2.15E+03		1.76E+03	2.36E+04		1.93E+04									
CV or beta (Min Qty, Max Qty)		0.13		0.13	0.14		0.14									
Quantity Unit:		Each (1000 ft duct)			Each (1000 ft duct)											
Repair Time:		P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:		1.93E+00	2.15E+00	2.65E+00	2.12E+01	2.37E+01	2.97E+01									
Best fit mean:		2.15E+00			2.37E+01											
Best Fit Distribution:		LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)		1.00		5.00	1.00		5.00									
Average Repair Time (Min Qty, Max Qty)		2.37E+00		1.94E+00	2.60E+01		2.13E+01									
CV or beta (Min Qty, Max Qty)		0.28		0.28	0.28		0.28									
Quantity Unit:		Each (1000 ft duct)			Each (1000 ft duct)											
LifeSafety Hazard:																
Potential non-collapse casualties? (Yes / No)		NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:		Not Applicable			50 SF											
Serious Injury (Median, Dispersion)		0%		0.00	10%		0.50									
Loss of Life (Median, Dispersion)		0%		0.00	0%		0.00									
Post-event Tagging Flag:		NO			NO											
Unsafe Placard Trigger (Median, Dispersion)		0%		0.00	0%		0.00									
Comments:		None														
Date Created:		Not Given														
Approved (YES / NO)?		By User														
Official (YES / NO) ?		By User														
Author:		Not Given														
Revisions:		None														
		Root Cost Multiplier: 1														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification D3041.022b
NISTIR Name HVAC Stainless Steel Ducting - 6 sq. ft cross sectional area or greater, SDC C
Description Costing based upon 1000 ft segments of duct

Line 528

Construction Quality:	Normal				
Seismic Installation Conditions:	Normal - SDC C				
Fragility Unit of Measure:	LF 1000				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	2				
Damage State:	DS1	DS2			
Type of Damage State:	Sequential				
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Individual supports fail and duct sags - 1 Several adjacent supports fail and sections of ducting fail - 60 feet of failed support per 1000 feet of ducting. ducting fail and fall per 1000 foot of ducting.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations					
	none	none			
Damage State Probability:	1.00	1.00			

Fragility Parameters					
Median Demand, θ :	1.5	2.25			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Superior				
Documentation Quality	Marginal				
Rationality	Marginal				
Consequence Functions					
Repair Description	Replace failed supports and repair ducting in vicinity of failed supports. Replace sections of failed ducting and supports.				

Long Lead Time (Yes / No) NO NO

Repair Costs:		P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:		1.75E+03	1.95E+03	2.40E+03	1.93E+04	2.15E+04	2.69E+04									
Best fit mean:		2.02E+03			2.23E+04											
Best Fit Distribution:		LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)		1.00		5.00	1.00		5.00									
Average Repair Cost (Min Qty, Max Qty)		2.15E+03		1.76E+03	2.36E+04		1.93E+04									
CV or beta (Min Qty, Max Qty)		0.13		0.13	0.14		0.14									
Quantity Unit:		Each (1000 ft duct)			Each (1000 ft duct)											
Repair Time:		P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:		1.93E+00	2.15E+00	2.65E+00	2.12E+01	2.37E+01	2.97E+01									
Best fit mean:		2.15E+00			2.37E+01											
Best Fit Distribution:		LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)		1.00		5.00	1.00		5.00									
Average Repair Time (Min Qty, Max Qty)		2.37E+00		1.94E+00	2.60E+01		2.13E+01									
CV or beta (Min Qty, Max Qty)		0.28		0.28	0.28		0.28									
Quantity Unit:		Each (1000 ft duct)			Each (1000 ft duct)											
LifeSafety Hazard:																
Potential non-collapse casualties? (Yes / No)		NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:		Not Applicable			50 SF											
Serious Injury (Median, Dispersion)		0%	0.00		10%	0.50										
Loss of Life (Median, Dispersion)		0%	0.00		0%	0.00										
Post-event Tagging Flag:		NO			NO											
Unsafe Placard Trigger (Median, Dispersion)		0%	0.00		0%	0.00										
Comments:		None														
Date Created:		Not Given														
Approved (YES / NO)?		By User														
Official (YES / NO) ?		By User														
Author:		Not Given														
Revisions:		None														
		Root Cost Multiplier: 1														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification D3041.022c
NISTIR Name HVAC Stainless Steel Ducting - 6 sq. ft cross sectional area or greater, SDC D, E, or F
Description Costing based upon 1000 ft segments of duct

Line 529

Construction Quality:	Normal				
Seismic Installation Conditions:	Normal - SDC D, E or F				
Fragility Unit of Measure:	LF 1000				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	2				
Damage State:	DS1	DS2			
Type of Damage State:	Sequential Sequential				
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Individual supports fail and duct sags - 1 Several adjacent supports fail and sections of ducting fail - 60 feet of failed support per 1000 feet of ducting. ducting fail and fall per 1000 foot of ducting.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations					
	none	none			
Damage State Probability:	1.00	1.00			

Fragility Parameters					
Median Demand, θ :	3.75	4.5			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Superior				
Documentation Quality	Marginal				
Rationality	Marginal				
Consequence Functions					
Repair Description	Replace failed supports and repair ducting in vicinity of failed supports. Replace sections of failed ducting and supports.				

Long Lead Time (Yes / No) NO NO

Repair Costs:		P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:		1.75E+03	1.95E+03	2.40E+03	1.93E+04	2.15E+04	2.69E+04									
Best fit mean:		2.02E+03			2.23E+04											
Best Fit Distribution:		LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)		1.00		5.00	1.00		5.00									
Average Repair Cost (Min Qty, Max Qty)		2.15E+03		1.76E+03	2.36E+04		1.93E+04									
CV or beta (Min Qty, Max Qty)		0.13		0.13	0.14		0.14									
Quantity Unit:		Each (1000 ft duct)			Each (1000 ft duct)											
Repair Time:		P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:		1.93E+00	2.15E+00	2.65E+00	2.12E+01	2.37E+01	2.97E+01									
Best fit mean:		2.15E+00			2.37E+01											
Best Fit Distribution:		LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)		1.00		5.00	1.00		5.00									
Average Repair Time (Min Qty, Max Qty)		2.37E+00		1.94E+00	2.60E+01		2.13E+01									
CV or beta (Min Qty, Max Qty)		0.28		0.28	0.28		0.28									
Quantity Unit:		Each (1000 ft duct)			Each (1000 ft duct)											
LifeSafety Hazard:																
Potential non-collapse casualties? (Yes / No)		NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:		Not Applicable			50 SF											
Serious Injury (Median, Dispersion)		0%		0.00	10%		0.50									
Loss of Life (Median, Dispersion)		0%		0.00	0%		0.00									
Post-event Tagging Flag:		NO			NO											
Unsafe Placard Trigger (Median, Dispersion)		0%		0.00	0%		0.00									
Comments:		None														
Date Created:		Not Given														
Approved (YES / NO)?		By User														
Official (YES / NO) ?		By User														
Author:		Not Given														
Revisions:		None														
		Root Cost Multiplier: 1														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification D3041.022d
NISTIR Name HVAC Stainless Steel Ducting - 6 sq. ft cross sectional area or greater, SDC D, E, or F (OSHDP or sim)
Description Costing based upon 1000 ft segments of duct

Line 530

Construction Quality: Special Regulation (e.g. OSHPD) for HVAC ducting installation
Seismic Installation Conditions: Special Regulation (e.g. OSHPD) for HVAC ducting installation - SDC D, E or F (high seismic design)

Fragility Unit of Measure: LF 1000
Demand Parameter (unit): Peak Floor Acceleration g
Number of Damage States: 2

Quantity Rounding Round Qty? NO
Allow sum by floor or building? NO
Demand Location (floor above?) Yes

Damage State:	DS1	DS2			
Type of Damage State:	Sequential				
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Individual supports fail and duct sags - 1 Several adjacent supports fail and sections of ducting fail - 60 feet of failed support per 1000 feet of ducting. ducting fail and fall per 1000 foot of ducting.				

Illustrations

none	none			
1.00	1.00			

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	3.75	4.5			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Superior				
Documentation Quality	Marginal				
Rationality	Marginal				
Consequence Functions					
Repair Description	Replace failed supports and repair ducting in vicinity of failed supports. Replace sections of failed ducting and supports.				

Long Lead Time (Yes / No) NO NO

Repair Costs:		P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:		1.75E+03	1.95E+03	2.40E+03	1.93E+04	2.15E+04	2.69E+04									
Best fit mean:		2.02E+03			2.23E+04											
Best Fit Distribution:		LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)		1.00		5.00	1.00		5.00									
Average Repair Cost (Min Qty, Max Qty)		2.15E+03		1.76E+03	2.36E+04		1.93E+04									
CV or beta (Min Qty, Max Qty)		0.13		0.13	0.14		0.14									
Quantity Unit:		Each (1000 ft duct)			Each (1000 ft duct)											
Repair Time:		P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:		1.93E+00	2.15E+00	2.65E+00	2.12E+01	2.37E+01	2.97E+01									
Best fit mean:		2.15E+00			2.37E+01											
Best Fit Distribution:		LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)		1.00		5.00	1.00		5.00									
Average Repair Time (Min Qty, Max Qty)		2.37E+00		1.94E+00	2.60E+01		2.13E+01									
CV or beta (Min Qty, Max Qty)		0.28		0.28	0.28		0.28									
Quantity Unit:		Each (1000 ft duct)			Each (1000 ft duct)											
LifeSafety Hazard:																
Potential non-collapse casualties? (Yes / No)		NO			YES											
Casualty-affected Planar Area (sf) per Normative Unit:		Not Applicable			50 SF											
Serious Injury (Median, Dispersion)		0%		0.00	10%		0.50									
Loss of Life (Median, Dispersion)		0%		0.00	0%		0.00									
Post-event Tagging Flag:		NO			NO											
Unsafe Placard Trigger (Median, Dispersion)		0%		0.00	0%		0.00									
Comments:		None														
Date Created:		Not Given														
Approved (YES / NO)?		By User														
Official (YES / NO) ?		By User														
Author:		Not Given														
Revisions:		None														
		Root Cost Multiplier: 1														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification D3041.031a
NISTIR Name HVAC Drops / Diffusers in suspended ceilings - No independent safety wires, SDC A or B
Description Costing per 10 units, No independent safety wires

Line 531

Construction Quality:	Normal				
Seismic Installation Conditions:	Normal - SDC A or B				
Fragility Unit of Measure:	EA 10				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	1				
Damage State:	DS1				
Type of Damage State:	Sequential				
DS Hierarchy	Seq(DS1)				
Descriptions	HVAC drops or diffusers dislodge and falls.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations					
	none				
Damage State Probability:	1.00				

Fragility Parameters					
Median Demand, θ :	1.3				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	0.4				
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Superior				
Documentation Quality	Marginal				
Rationality	Marginal				
Consequence Functions					
Repair Description	Replace diffuser/drop and sections of ceiling and ducting in vicinity to which diffuser/drop is connected.				

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.00E+03	3.00E+03	3.50E+03												
Best fit mean:	2.83E+03														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Cost (Min Qty, Max Qty)	3.30E+03		2.70E+03												
CV or beta (Min Qty, Max Qty)	0.21		0.21												
Quantity Unit:	10 Units														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.35E+00	3.53E+00	4.12E+00												
Best fit mean:	3.53E+00														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Time (Min Qty, Max Qty)	3.88E+00		3.18E+00												
CV or beta (Min Qty, Max Qty)	0.32		0.32												
Quantity Unit:	10 Units														
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	YES														
Casualty-affected Planar Area (sf) per Normative Unit:	4 SF														
Serious Injury (Median, Dispersion)	10%	0.50													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	One failure is expected per 10 units.														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														

Root Cost Multiplier: 10

FEMA P-58 Fragility Specification

NISTIR Classification D3041.031b
NISTIR Name HVAC Drops / Diffusers in suspended ceilings - No independent safety wires, SDC C
Description Costing per 10 units, No independent safety wires

Line 532

Construction Quality:	Normal				
Seismic Installation Conditions:	Normal - SDC C				
Fragility Unit of Measure:	EA 10				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	1				
Damage State:	DS1				
Type of Damage State:	Sequential				
DS Hierarchy	Seq(DS1)				
Descriptions	HVAC drops or diffusers dislodges and falls.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations					
	none				
Damage State Probability:	1.00				

Fragility Parameters					
Median Demand, θ :	1.3				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	0.4				
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Superior				
Documentation Quality	Marginal				
Rationality	Marginal				
Consequence Functions					
Repair Description	Replace diffuser/drop and sections of ceiling and ducting in vicinity to which diffuser/drop is connected.				

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.00E+03	3.00E+03	3.50E+03												
Best fit mean:	2.83E+03														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Cost (Min Qty, Max Qty)	3.30E+03		2.70E+03												
CV or beta (Min Qty, Max Qty)	0.21		0.21												
Quantity Unit:	10 Units														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.35E+00	3.53E+00	4.12E+00												
Best fit mean:	3.53E+00														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Time (Min Qty, Max Qty)	3.88E+00		3.18E+00												
CV or beta (Min Qty, Max Qty)	0.32		0.32												
Quantity Unit:	10 Units														
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	YES														
Casualty-affected Planar Area (sf) per Normative Unit:	4 SF														
Serious Injury (Median, Dispersion)	10%	0.50													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	One failure is expected per 10 units.														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														

Root Cost Multiplier: 10

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3041.032a

HVAC Drops / Diffusers without ceilings - supported by ducting only - No independent safety wires, SDC A or B

Costing per 10 units, unit supported by ducting only, no independent safety wires

Line 533

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

Normal - SDC A or B

EA 10

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

HVAC drops or diffusers dislodge and falls.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO

Yes

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.5

Not Specified

Not Specified

0.4

NO

NO

Marginal

Superior

Marginal

Marginal

Replace diffuser/drop and sections of ceiling and ducting in vicinity to which diffuser/drop is connected.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.00E+03

3.00E+03

3.50E+03

2.83E+03

Normal

1.00

5.00

3.30E+03

2.70E+03

0.21

0.21

10 Units

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.35E+00

3.53E+00

4.12E+00

3.53E+00

Normal

1.00

5.00

3.88E+00

3.18E+00

0.32

0.32

10 Units

YES

4 SF

10%

0.50

0%

0.00

NO

0%

0.00

One failure is expected per 10 units.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

10

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3041.032b

HVAC Drops / Diffusers without ceilings - supported by ducting only - No independent safety wires, SDC C

Costing per 10 units, unit supported by ducting only, no independent safety wires

Line 534

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

Normal - SDC C

EA 10

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

HVAC drops or diffusers dislodge and falls.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO

Yes

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.5

Not Specified

Not Specified

0.4

NO

NO

Marginal

Superior

Marginal

Marginal

Replace diffuser/drop and sections of ceiling and ducting in vicinity to which diffuser/drop is connected.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.00E+03

3.00E+03

3.50E+03

2.83E+03

Normal

1.00

5.00

3.30E+03

2.70E+03

0.21

0.21

10 Units

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.35E+00

3.53E+00

4.12E+00

3.53E+00

Normal

1.00

5.00

3.88E+00

3.18E+00

0.32

0.32

10 Units

YES

4 SF

10%

0.50

0%

0.00

NO

0%

0.00

One failure is expected per 10 units.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

10

FEMA P-58 Fragility Specification

NISTIR Classification D3041.032c
NISTIR Name HVAC Drops / Diffusers without ceilings - supported by ducting only - No independent safety wires, SDC D, E, or F
Description Costing per 10 units, unit supported by ducting only, no independent safety wires

Line 535

Construction Quality:	Normal				
Seismic Installation Conditions:	Normal - SDC D, E or F				
Fragility Unit of Measure:	EA 10				
Demand Parameter (unit):	Peak Floor Acceleration g				
Number of Damage States:	1				
Damage State:	DS1				
Type of Damage State:	Sequential				
DS Hierarchy	Seq(DS1)				
Descriptions	HVAC drops or diffusers dislodges and falls.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations					
	none				
Damage State Probability:	1.00				

Fragility Parameters					
Median Demand, θ :	1.5				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	0.4				
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Superior				
Documentation Quality	Marginal				
Rationality	Marginal				
Consequence Functions					
Repair Description	Replace diffuser/drop and sections of ceiling and ducting in vicinity to which diffuser/drop is connected.				

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	2.00E+03	3.00E+03	3.50E+03												
Best fit mean:	2.83E+03														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Cost (Min Qty, Max Qty)	3.30E+03		2.70E+03												
CV or beta (Min Qty, Max Qty)	0.21		0.21												
Quantity Unit:	10 Units														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.35E+00	3.53E+00	4.12E+00												
Best fit mean:	3.53E+00														
Best Fit Distribution:	Normal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Time (Min Qty, Max Qty)	3.88E+00		3.18E+00												
CV or beta (Min Qty, Max Qty)	0.32		0.32												
Quantity Unit:	10 Units														
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	YES														
Casualty-affected Planar Area (sf) per Normative Unit:	4 SF														
Serious Injury (Median, Dispersion)	10%	0.50													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	One failure is expected per 10 units.														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														

Root Cost Multiplier: 10

FEMA P-58 Fragility Specification

NISTIR Classification D3041.041a
NISTIR Name Variable Air Volume (VAV) box with in-line coil, SDC A or B
Description Costing per 10 units

Line 537

Construction Quality:	Normal					Quantity Rounding		Round Qty?	NO
Seismic Installation Conditions:	Normal - SDC A or B					Allow sum by floor or building?		NO	
Fragility Unit of Measure:	EA 10					Demand Location (floor above?)		Yes	
Demand Parameter (unit):	Peak Floor Acceleration	g							
Number of Damage States:	1								
Damage State:	DS1								
Type of Damage State:	Sequential								
DS Hierarchy	Seq(DS1)								
Descriptions	Coil damages connection to plumbing. Leakage of hot water.								

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations					
	none				
Damage State Probability:	1.00				

Fragility Parameters					
Median Demand, θ :	1.9				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	0.4				
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Superior				
Documentation Quality	Marginal				
Rationality	Marginal				
Consequence Functions					
Repair Description	Replace coil and cleanup water damage.				

Long Lead Time (Yes / No) NO

Repair Costs:				P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	
Repair Cost by Damage State:				1.00E+04	1.50E+04	2.15E+04										
Best fit mean:				1.48E+04												
Best Fit Distribution:				LogNormal												
Quantity Plateau (Min Qty, Max Qty)				1.00		5.00										
Average Repair Cost (Min Qty, Max Qty)				1.65E+04		1.35E+04										
CV or beta (Min Qty, Max Qty)				0.29		0.29										
Quantity Unit:				10 Units												
Repair Time:				P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	
Repair Time by Damage State:				1.18E+01	1.76E+01	2.53E+01										
Best fit mean:				1.76E+01												
Best Fit Distribution:				LogNormal												
Quantity Plateau (Min Qty, Max Qty)				1.00		5.00										
Average Repair Time (Min Qty, Max Qty)				1.94E+01		1.59E+01										
CV or beta (Min Qty, Max Qty)				0.39		0.39										
Quantity Unit:				10 Units												
LifeSafety Hazard:																
Potential non-collapse casualties? (Yes / No)				NO												
Casualty-affected Planar Area (sf) per Normative Unit:				Not Applicable												
Serious Injury (Median, Dispersion)				0%	0.00											
Loss of Life (Median, Dispersion)				0%	0.00											
Post-event Tagging Flag:				NO												
Unsafe Placard Trigger (Median, Dispersion)				0%	0.00											
Comments: One failure is expected per 10 units.																
Date Created:				Not Given									Root Cost Multiplier: 10			
Approved (YES / NO)?				By User												
Official (YES / NO) ?				By User												
Author:				Not Given												
Revisions:				None												

Root Cost Multiplier: 10

FEMA P-58 Fragility Specification

NISTIR Classification D3041.041b
NISTIR Name Variable Air Volume (VAV) box with in-line coil, SDC C
Description Costing per 10 units

Line 538

Construction Quality:	Normal					Quantity Rounding		Round Qty?	NO
Seismic Installation Conditions:	Normal - SDC C					Allow sum by floor or building?		NO	
Fragility Unit of Measure:	EA 10					Demand Location (floor above?)		Yes	
Demand Parameter (unit):	Peak Floor Acceleration	g							
Number of Damage States:	1								
Damage State:	DS1								
Type of Damage State:	Sequential								
DS Hierarchy	Seq(DS1)								
Descriptions	Coil damages connection to plumbing. Leakage of hot water.								

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations					
	none				
Damage State Probability:	1.00				

Fragility Parameters					
Median Demand, θ :	1.9				
Data dispersion, β_d :	Not Specified				
Uncertainty, β_u :	Not Specified				
Total Dispersion, β :	0.4				
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Superior				
Documentation Quality	Marginal				
Rationality	Marginal				
Consequence Functions					
Repair Description	Replace coil and cleanup water damage.				

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.00E+04	1.50E+04	2.15E+04												
Best fit mean:	1.48E+04														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Cost (Min Qty, Max Qty)	1.65E+04		1.35E+04												
CV or beta (Min Qty, Max Qty)	0.29		0.29												
Quantity Unit:	10 Units														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.18E+01	1.76E+01	2.53E+01												
Best fit mean:	1.76E+01														
Best Fit Distribution:	LogNormal														
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00												
Average Repair Time (Min Qty, Max Qty)	1.94E+01		1.59E+01												
CV or beta (Min Qty, Max Qty)	0.39		0.39												
Quantity Unit:	10 Units														
LifeSafety Hazard:	NO														
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	One failure is expected per 10 units.														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														

Root Cost Multiplier: 10

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3041.101a

HVAC Fan - Capacity: all - Unanchored equipment that is not vibration isolated - Equipment fragility only

Costing is per unit.

Line 539

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Unanchored equipment that is not vibration isolated

EA 1

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

BLDG

No

Illustrations



D3041.101a-DS1-1.JPG

Damage State Probability:

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

0.5

0.4

0.1

0.4

NO

NO

Average

Average

Superior

Superior

Replace equipment.

Long Lead Time (Yes / No)

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Each

2.20E+03

2.65E+03

3.15E+03

2.92E+03

0.14

2.64E+03

LogNormal

1.00

5.00

2.39E+03

0.14

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Each

2.59E+00

3.12E+00

3.71E+00

3.43E+00

0.29

3.12E+00

LogNormal

1.00

5.00

2.81E+00

0.29

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification


NISTIR Classification D3041.102a
NISTIR Name HVAC Fan - Capacity: all - Vibration isolated equipment that is not snubbed or restrained - Anchorage fragility only
Description Costing is per unit.

Line 540

Construction Quality:	Normal - Not designed for seismic loads			
Seismic Installation Conditions:	Vibration isolated equipment that is not snubbed or restrained			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	2			
Damage State:	DS1	DS2		
Type of Damage State:	Mutually Exclusive		Mutually Exclusive	
DS Hierarchy	MutEx(DS1,DS2)			
Descriptions	Anchorage failure.		Anchorage failure & Equipment damaged beyond repair.	

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?	BLDG	
Demand Location (floor above?)	No	

Illustrations

				
D3041.101a-DS1-1.JPG	none			
0.70	0.30			

Damage State Probability:				
Fragility Parameters				
Median Demand, θ :	By User	By User		
Data dispersion, β_d :	User to Calculate	User to Calculate		
Uncertainty, β_u :	User to Calculate	User to Calculate		
Total Dispersion, β_t :	By User	By User		
Correlation (Yes / No)	NO			
Directionality (Yes / No)	NO			
Quality Ratings				
Data Quality	Average			
Data Relevance	Average			
Documentation Quality	Superior			
Rationality	Superior			
Consequence Functions				
Repair Description	Repair anchorage and remount equipment.	Repair anchorage and replace equipment.		

Long Lead Time (Yes / No) NO YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	5.00E+02	7.00E+02	1.15E+03	2.70E+03	3.35E+03	4.30E+03									
Best fit mean:	7.34E+02			3.39E+03											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Cost (Min Qty, Max Qty)	7.70E+02		6.30E+02	3.69E+03		3.02E+03									
CV or beta (Min Qty, Max Qty)	0.34		0.34	0.18		0.18									
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	5.88E-01	8.24E-01	1.35E+00	3.18E-01	3.94E-01	5.06E-01									
Best fit mean:	8.24E-01			3.94E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Time (Min Qty, Max Qty)	9.06E-01		7.41E-01	7.88E-01		1.97E-01									
CV or beta (Min Qty, Max Qty)	0.42		0.42	0.31		0.31									
Quantity Unit:	Each			Each											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										
Comments: User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.															
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														
Root Cost Multiplier: 1															

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3041.102b

HVAC Fan - Capacity: all - Vibration isolated equipment that is not snubbed or restrained - Equipment fragility only

Costing is per unit.

Line 541

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

EA 1

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

BLDG

No

Illustrations



D3041.101a-DS1-1.JPG

Damage State Probability:

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1

0.6

0.1

0.6

NO

NO

Average

Average

Superior

Superior

Replace equipment.

Long Lead Time (Yes / No)

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau

(Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau

(Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties?

(Yes / No)

Casualty-affected Planar Area (sf)

per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.20E+03

2.65E+03

3.15E+03

LogNormal

1.00

5.00

2.92E+03

2.39E+03

0.14

0.14

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.59E+00

3.12E+00

3.71E+00

LogNormal

1.00

5.00

3.43E+00

2.81E+00

0.29

0.29

Each

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Dispersion:	0%	0.00	0%	0.00	0%	0.00	
Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.						
Date Created:	Not Given						Root Cost Multiplier: 1
Approved (YES / NO)?	By User						
Official (YES / NO) ?	By User						
Author:	Not Given						
Revisions:	None						

Root Cost Multiplier: 1

Root Cost Multiplier: 1

User to pro	
Not Given	
By User	
By User	
Not Given	
None	

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

D3052.011a

Air Handling Unit - Capacity: <5000 CFM - Unanchored equipment that is not vibration isolated - Equipment fragility only
Costing is per unit and is based upon 4000 CFM.

Line 546

Construction Quality:	Normal - Not designed for seismic loads			
Seismic Installation Conditions:	Unanchored equipment that is not vibration isolated			
Fragility Unit of Measure:	CF 4000			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	2			
Damage State:	DS1	DS2		
Type of Damage State:	Mutually Exclusive		Mutually Exclusive	
DS Hierarchy	MutEx(DS1,DS2)			
Descriptions	Equipment does not function. Damage to attached ducting or piping.		Equipment does not function Equipment damaged beyond repair.	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		BLDG
Demand Location (floor above?)		No

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		BLDG
Demand Location (floor above?)		No

Illustrations

				
D3052.011b-DS1-1.JPG	none			

Damage State Probability:	0.67	0.33			
Fragility Parameters					
Median Demand, θ :	0.25	0.25			
Data dispersion, β_d :	0.4	0.40			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Average				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Repair attached ducting or piping. Replace equipment. Remove, repair offsite, and reinstall air handler.				

Long Lead Time (Yes / No)

NO YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	9.00E+02	1.00E+03	1.30E+03	2.51E+04	2.92E+04	3.78E+04									
Best fit mean:	1.05E+03			3.02E+04											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Cost (Min Qty, Max Qty)	1.10E+03		9.00E+02	3.21E+04		2.63E+04									
CV or beta (Min Qty, Max Qty)	0.15		0.15	0.17		0.17									
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	3.18E-01	3.53E-01	4.59E-01	5.91E+00	6.87E+00	8.89E+00									
Best fit mean:	3.53E-01			6.87E+00											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Time (Min Qty, Max Qty)	4.71E-01		2.35E-01	1.03E+01		3.44E+00									
CV or beta (Min Qty, Max Qty)	0.29		0.29	0.30		0.30									
Quantity Unit:	Each			Each											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	2016-10-25 - Clarified repair.														
	Root Cost Multiplier: 1														

Root Cost Multiplier: 1

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

D3052.011c

Air Handling Unit - Capacity: 10000 to <25000 CFM - Unanchored equipment that is not vibration isolated - Equipment fragility only
Costing is per unit and is based upon 20000 CFM.

Line 548

Construction Quality:	Normal - Not designed for seismic loads				<div>Quantity RoundingRound Qty? YES</div> <div>Allow sum by floor or building? BLDG</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Unanchored equipment that is not vibration isolated				
Fragility Unit of Measure:	CF 20000				
Demand Parameter (unit):	Peak Floor Accelerationg				
Number of Damage States:	2				
Damage State:	DS1		DS2		
Type of Damage State:	Mutually Exclusive		Mutually Exclusive		
DS Hierarchy	MutEx(DS1,DS2)				
Descriptions	Equipment does not function. Damage to attached ducting or piping.		Equipment does not function Equipment damaged beyond repair.		

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		BLDG
Demand Location (floor above?)	No	

Illustrations

				
D3052.011b-DS1-1.JPG	none			

Damage State Probability:	0.67	0.33			
Fragility Parameters					
Median Demand, θ :	0.25	0.25			
Data dispersion, β_d :	0.4	0.40			
Uncertainty, β_u :	0.1	0.1			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Average				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Repair attached ducting or piping. Replace equipment. Remove, repair offsite, and reinstall air handler.				

Long Lead Time (Yes / No)

NO YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.70E+03	2.00E+03	2.60E+03	1.06E+05	1.25E+05	1.64E+05									
Best fit mean:	2.07E+03			1.29E+05											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Cost (Min Qty, Max Qty)	2.20E+03		1.80E+03	1.38E+05		1.13E+05									
CV or beta (Min Qty, Max Qty)	0.17		0.17	0.17		0.17									
Quantity Unit:	Each			Each											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	2.00E+00	2.35E+00	3.06E+00	1.25E+01	1.47E+01	1.92E+01									
Best fit mean:	2.35E+00			1.47E+01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00									
Average Repair Time (Min Qty, Max Qty)	2.59E+00		2.12E+00	2.95E+01		7.36E+00									
CV or beta (Min Qty, Max Qty)	0.30		0.30	0.30		0.30									
Quantity Unit:	Each			Each											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	2016-10-25 - Clarified repair.														
							Root Cost Multiplier: 1								

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3052.011d

Air Handling Unit - Capacity: 25000 to <40000 CFM - Unanchored equipment that is not vibration isolated - Equipment fragility only

Costing is per unit and is based upon 30000 CFM.

Line 549

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Unanchored equipment that is not vibration isolated

CF 30000

Peak Floor Acceleration

2

DS1

DS2

Mutually Exclusive

MutEx(DS1,DS2)

Equipment does not function. Damage to attached ducting or piping.

Equipment does not function Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

YES

BLDG

No

Illustrations

D3052.011b-DS1-1.JPG

none

Damage State Probability:

0.67

0.33

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

0.25

0.4

0.1

0.4

NO

NO

Average

Average

Superior

Superior

Repair attached ducting or piping.

Replace equipment. Remove, repair offsite, and reinstall air handler.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

1.70E+03

2.00E+03

2.60E+03

P₁₀

P₅₀

P₉₀

1.58E+05

1.86E+05

2.43E+05

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.07E+03

LogNormal

1.00

5.00

2.20E+03

1.80E+03

0.17

0.17

Each

1.82E+05

LogNormal

1.00

5.00

2.05E+05

1.67E+05

0.17

0.17

Each

P₁₀

P₅₀

P₉₀

2.00E+00

2.35E+00

3.06E+00

P₁₀

P₅₀

P₉₀

1.30E+01

1.53E+01

2.00E+01

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.35E+00

LogNormal

1.00

5.00

2.59E+00

2.12E+00

0.30

0.30

Each

1.53E+01

LogNormal

1.00

5.00

3.72E+01

7.66E+00

0.30

0.30

Each

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

0%

0.00

NO

NO

0%

0.00

0%

0.00

None

Not Given

By User

By User

Not Given

2016-10-25 - Clarified repair.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3052.013b

Air Handling Unit - Capacity: <5000 CFM - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility only

Costing is per unit and is based upon 4000 CFM.

Line 551

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

CF 4000

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

Mutually Exclusive

MutEx(DS1,DS2)

Equipment does not function but anchorage is OK. Damage to attached ducting or piping.

Equipment does not function but anchorage is OK. Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

YES

BLDG

No

Illustrations



D3052.011b-DS1-1.JPG

none

Damage State Probability:

0.67

0.33

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.54

0.6

0.1

0.6

NO

NO

Average

Average

Superior

Superior

Repair attached ducting or piping.

Replace equipment. Remove, repair offsite, and reinstall air handler.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

9.00E+02

1.00E+03

1.30E+03

P₁₀

P₅₀

P₉₀

2.51E+04

2.92E+04

3.78E+04

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.00E+03

LogNormal

1.00

5.00

1.10E+03

9.00E+02

0.15

0.15

Each

P₁₀

P₅₀

P₉₀

3.18E-01

3.53E-01

4.59E-01

P₁₀

P₅₀

P₉₀

5.91E+00

6.87E+00

8.89E+00

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.53E-01

LogNormal

1.00

5.00

4.71E-01

2.35E-01

0.29

0.29

Each

P₁₀

P₅₀

P₉₀

1.03E+01

3.44E+00

0.30

0.30

Each

NO

Not Applicable

0%

0.00

0%

0.00

NO

NO

0%

0.00

NO

NO

0%

0.00

None

Not Given

By User

By User

Not Given

2016-10-25 - Clarified repair.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3052.013c



Air Handling Unit - Capacity: <5000 CFM - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/isolato

Costing is per unit and is based upon 4000 CFM.

Line 552

Construction Quality:	Normal - Designed for seismic loads but no special seismic certification			
Seismic Installation Conditions:	Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints			
Fragility Unit of Measure:	CF 4000			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	4			
Damage State:	DS1	DS2	DS3	DS4
Type of Damage State:	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive
DS Hierarchy	MutEx(DS1,DS2,DS3,DS4)			
Descriptions	Anchorage failure.	Anchorage failure & Equipment damaged beyond repair.	Damage to attached ducting or piping but anchorage is OK.	Equipment damaged beyond repair but anchorage is OK.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		BLDG
Demand Location (floor above?)		No

Illustrations		none		none	
Damage State Probability:	0.35	0.15	0.35	0.15	
Fragility Parameters					
Median Demand, θ :	By User	By User	By User	By User	
Data dispersion, β_d :	User to Calculate	User to Calculate	User to Calculate	User to Calculate	
Uncertainty, β_u :	User to Calculate	User to Calculate	User to Calculate	User to Calculate	
Total Dispersion, β :	By User	By User	By User	By User	
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Average				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Repair anchorage and concrete pad and remount equipment.	Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Remove, repair offsite, and reinstall air handler.	Repair attached ducting or piping - equipment does not require replacement and anchorage does not require repair	Replace and install equipment including new anchorage if anchorage is post-installed.	

Long Lead Time (Yes / No)	NO			YES			NO			YES						
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	
Repair Cost by Damage State:	5.00E+02	1.00E+03	1.70E+03	2.56E+04	3.02E+04	3.95E+04	9.00E+02	1.00E+03	1.30E+03	2.51E+04	2.92E+04	3.78E+04				
Best fit mean:	9.59E+02			3.12E+04			1.05E+03			3.02E+04						
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal						
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00	1.00		5.00				
Average Repair Cost (Min Qty, Max Qty)	1.10E+03		9.00E+02	3.32E+04		2.72E+04	1.10E+03		9.00E+02	3.21E+04		2.63E+04				
CV or beta (Min Qty, Max Qty)	0.45		0.45	0.18		0.18	0.15		0.15	0.17		0.17				
Quantity Unit:	Each			Each			Each			Each						
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	
Repair Time by Damage State:	5.88E-01	1.18E+00	2.00E+00	6.02E+00	7.11E+00	9.29E+00	2.12E-01	2.35E-01	3.06E-01	5.91E+00	6.87E+00	8.89E+00				
Best fit mean:	1.18E+00			7.11E+00			2.35E-01			6.87E+00						
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal						
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00	1.00		5.00				
Average Repair Time (Min Qty, Max Qty)	1.29E+00		1.06E+00	1.07E+01		3.55E+00	3.53E-01		1.18E-01	1.03E+01		3.44E+00				
CV or beta (Min Qty, Max Qty)	0.52		0.52	0.31		0.31	0.29		0.29	0.30		0.30				
Quantity Unit:	Each			Each			Each			Each						
LifeSafety Hazard:																
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO						
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable						
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00					
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00					
Post-event Tagging Flag:	NO			NO			NO			NO						
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00					
Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.															
Date Created:	Not Given															
Approved (YES / NO)?	By User															
Official (YES / NO) ?	By User															
Author:	Not Given															
Revisions:	2016-10-25 - Clarified repair.															
													Root Cost Multiplier:			1

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3052.013d

Air Handling Unit - Capacity: 5000 to <10000 CFM - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragility

Costing is per unit and is based upon 8000 CFM.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

CF 8000

Peak Floor Acceleration

2

DS1

Mutually Exclusive

MutEx(DS1,DS2)

Anchorage failure.

DS2

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

YES

BLDG

No

Illustrations



D3052.011c-DS1-1.JPG

none

Damage State Probability:

0.70

0.30

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β_t :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User

User to Calculate

User to Calculate

By User

NO

NO

Average

Average

Superior

Superior

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Remove, repair offsite, and reinstall air handler.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

8.00E+02

1.50E+03

2.40E+03

5.13E+04

6.05E+04

7.97E+04

1.57E+03

Normal

1.00

5.00

1.00

5.00

1.65E+03

1.35E+03

6.66E+04

5.45E+04

0.40

0.40

0.18

0.18

Each

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

9.41E-01

1.76E+00

2.82E+00

9.05E+00

1.07E+01

1.41E+01

1.76E+00

Normal

1.00

5.00

1.00

5.00

1.94E+00

1.59E+00

1.78E+01

5.34E+00

0.47

0.47

0.31

0.31

Each

Each

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

NO

NO

0%

0.00

0%

0.00

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

2016-10-25 - Clarified repair.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3052.013e

Air Handling Unit - Capacity: 5000 to <10000 CFM - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility

Line 554

Costing is per unit and is based upon 8000 CFM.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

CF 8000

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

Mutually Exclusive

MutEx(DS1,DS2)

Equipment does not function but anchorage is OK. Damage to attached ducting or piping.

Equipment does not function but anchorage is OK. Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations



D3052.011b-DS1-1.JPG

none

Damage State Probability:

0.67

0.33

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.54

0.6

0.1

0.6

NO

NO

Average

Average

Superior

Superior

Repair attached ducting or piping.

Replace equipment. Remove, repair offsite, and reinstall air handler.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.30E+03

1.50E+03

2.00E+03

5.05E+04

5.90E+04

7.73E+04

1.57E+03

LogNormal

1.00

5.00

1.00

5.00

1.65E+03

1.35E+03

6.49E+04

5.31E+04

0.18

0.18

0.17

0.17

Each

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

4.59E-01

5.29E-01

7.06E-01

8.91E+00

1.04E+01

1.36E+01

5.29E-01

LogNormal

1.00

5.00

1.00

5.00

7.06E-01

3.53E-01

1.74E+01

5.21E+00

0.31

0.31

0.30

0.30

Each

Each

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

NO

NO

0%

0.00

0%

0.00

None

Not Given

By User

By User

Not Given

2016-10-25 - Clarified repair.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

D3052.013f

Line 555

NISTIR Name
Description

Air Handling Unit - Capacity: 5000 to <10000 CFM - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage
Costing is per unit and is based upon 8000 CFM.

Construction Quality: Normal - Designed for seismic loads but no special seismic certification
Seismic Installation Conditions: Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

Fragility Unit of Measure: CF 8000

Demand Parameter (unit): Peak Floor Acceleration g

Number of Damage States: 4

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

DS1

Mutually Exclusive

MutEx(DS1,DS2,DS3,DS4)

Anchorage failure.

DS2

Mutually Exclusive

Anchorage failure & Equipment
damaged beyond repair.

DS3

Mutually Exclusive

Damage to attached ducting or piping
but anchorage is OK.

DS4

Mutually Exclusive

Equipment damaged beyond repair but
anchorage is OK.

Quantity Rounding Round Qty? YES
Allow sum by floor or building? BLDG
Demand Location (floor above?) No

Illustrations

				
D3052.011a-DS1-1.JPG	none	D3052.011b-DS1-1.JPG	none	
0.35	0.15	0.35	0.15	

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β_t :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User

User to Calculate

User to Calculate

By User

NO

NO

Average

Average

Superior

Superior

Repair anchorage and concrete pad and
remount equipment.

Replace equipment including attached
utilities in addition to repairing
anchorage and concrete pad. Remove,
repair offsite, and reinstall air handler.

Repair attached ducting or piping -
equipment does not require
replacement and anchorage does not
require repair

Replace and install equipment including
new anchorage if anchorage is post-
installed.

Long Lead Time (Yes / No)

NO

YES

NO

YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	8.00E+02	1.50E+03	2.40E+03	5.13E+04	6.05E+04	7.97E+04	1.30E+03	1.50E+03	2.00E+03	5.05E+04	5.90E+04	7.73E+04			
Best fit mean:	1.57E+03			6.27E+04			1.57E+03			6.12E+04					
Best Fit Distribution:	Normal			LogNormal			LogNormal			LogNormal					
Quantity Plateau	1.00			1.00			1.00			1.00					
(Min Qty, Max Qty)															
Average Repair Cost (Min Qty, Max Qty)	1.65E+03			6.66E+04			1.65E+03			6.49E+04			5.31E+04		
CV or beta (Min Qty, Max Qty)	0.40			0.18			0.18			0.17			0.17		
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	9.41E-01	1.76E+00	2.82E+00	9.05E+00	1.07E+01	1.41E+01	3.06E-01	3.53E-01	4.71E-01	8.91E+00	1.04E+01	1.36E+01			
Best fit mean:	1.76E+00			1.07E+01			3.53E-01			1.04E+01					
Best Fit Distribution:	Normal			LogNormal			LogNormal			LogNormal					
Quantity Plateau	1.00			1.00			1.00			1.00					
(Min Qty, Max Qty)															
Average Repair Time (Min Qty, Max Qty)	1.94E+00			1.78E+01			5.29E-01			1.74E+01			5.21E+00		
CV or beta (Min Qty, Max Qty)	0.47			0.31			0.31			0.30			0.30		
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0%			0%			0%			0%					
Loss of Life (Median, Dispersion)	0%			0%			0%			0%					
Post-event Tagging Flag:	NO			NO			NO			NO					
Unsafe Placard Trigger (Median, Dispersion)	0%			0%			0%			0%					

Comments: User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

Not Given

By User

By User

Not Given

2016-10-25 - Clarified repair.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3052.013g

Air Handling Unit - Capacity: 10000 to <25000 CFM - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragility

Line 556

Costing is per unit and is based upon 20000 CFM.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

CF 20000

Peak Floor Acceleration

2

DS1

Mutually Exclusive

MutEx(DS1,DS2)

Anchorage failure.

DS2

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES


Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

				
D3052.011c-DS1-1.JPG	none			

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

0.70

0.30

By User

User to Calculate

User to Calculate

By User

NO

NO

Average

Average

Superior

Superior

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Remove, repair offsite, and reinstall air handler.

Long Lead Time (Yes / No) NO YES

Repair Costs:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}												
Repair Cost by Damage State:	1.40E+03	2.20E+03	3.10E+03	1.08E+05	1.27E+05	1.67E+05																					
Best fit mean:	2.23E+03			1.32E+05																							
Best Fit Distribution:	Normal			LogNormal																							
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00																							
Average Repair Cost (Min Qty, Max Qty)	2.42E+03 1.98E+03			1.40E+05 1.15E+05																							
CV or beta (Min Qty, Max Qty)	0.30 0.30			0.18 0.18																							
Quantity Unit:	Each			Each																							
Repair Time:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}												
Repair Time by Damage State:	4.94E-01	7.77E-01	1.09E+00	1.27E+01	1.50E+01	1.96E+01																					
Best fit mean:	7.77E-01			1.50E+01																							
Best Fit Distribution:	Normal			LogNormal																							
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00			1.00 5.00																							
Average Repair Time (Min Qty, Max Qty)	1.04E+00 5.18E-01			3.00E+01 7.49E+00																							
CV or beta (Min Qty, Max Qty)	0.39 0.39			0.31 0.31																							
Quantity Unit:	Each			Each																							
LifeSafety Hazard:	NO			NO																							
Potential non-collapse casualties? (Yes / No)																											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable																							
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00																							
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00																							
Post-event Tagging Flag:	NO			NO																							
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00																							
Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.																										
Date Created:	Not Given																										
Approved (YES / NO)?	By User																										
Official (YES / NO)?	By User																										
Author:	Not Given																										
Revisions:	2016-10-25 - Clarified repair.																										

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3052.013h

Air Handling Unit - Capacity: 10000 to <25000 CFM - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints
Costing is per unit and is based upon 20000 CFM.

Line 557

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

CF 20000

Peak Floor Acceleration

2

DS1

DS2

Mutually Exclusive

MutEx(DS1,DS2)

Equipment does not function but anchorage is OK. Damage to attached ducting or piping.

Equipment does not function but anchorage is OK. Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

Allow sum by floor or building?


Demand Location (floor above?)

YES

BLDG

No

Illustrations



D3052.011b-DS1-1.JPG

none

Damage State Probability:

0.67

0.33

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.54

1.54

0.6

0.60

0.1

0.1

0.6

0.6

NO

NO

Average

Average

Superior

Superior

Repair attached ducting or piping.

Replace equipment. Remove, repair offsite, and reinstall air handler.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.70E+03

2.00E+03

2.60E+03

1.06E+05

1.25E+05

1.64E+05

2.07E+03

LogNormal

1.00

5.00

1.00

5.00

2.20E+03

1.80E+03

1.38E+05

1.13E+05

0.17

0.17

Each

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.00E+00

2.35E+00

3.06E+00

1.25E+01

1.47E+01

1.92E+01

2.35E+00

LogNormal

1.00

5.00

1.00

5.00

2.59E+00

2.12E+00

2.95E+01

7.36E+00

0.30

0.30

Each

Each

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

NO

NO

0%

0.00

0%

0.00

None

Not Given

By User

By User

Not Given

2016-10-25 - Clarified repair.

Root Cost Multiplier: 1

Not Given
2016-10-25 - Clarified repair.

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.		
Date Created:	Not Given	Root Cost Multiplier:	1
Approved (YES / NO)?	By User		
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	2016-10-25 - Clarified repair.		

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3052.013k

Air Handling Unit - Capacity: 25000 to <40000 CFM - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility
Costing is per unit and is based upon 30000 CFM.

Line 560

Construction Quality:Normal - Designed for seismic loads but no special seismic certification

Seismic Installation Conditions:Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

Quantity RoundingRound Qty? YES

Fragility Unit of Measure:CF 30000

Allow sum by floor or building? BLDG

Demand Parameter (unit):Peak Floor Accelerationg

Demand Location (floor above?) No

Number of Damage States:2


Damage State:DS1DS2

Type of Damage State:Mutually ExclusiveMutually Exclusive

DS HierarchyMutEx(DS1,DS2)

DescriptionsEquipment does not function but anchorage is OK. Damage to attached ducting or piping.Equipment does not function but anchorage is OK. Equipment damaged beyond repair.

Illustrations



D3052.011b-DS1-1.JPG

none

Damage State Probability:

0.670.33

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

1.540.60.10.6

1.540.60.10.6

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

NO

NO

Average

Average

Superior

Superior

Repair attached ducting or piping.

Replace equipment. Remove, repair offsite, and reinstall air handler.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

P₁₀P₅₀P₉₀

1.70E+032.00E+032.60E+03

2.07E+03LogNormal

1.005.00

2.20E+031.80E+03

0.170.17

P₁₀P₅₀P₉₀

1.58E+051.86E+052.43E+05

1.82E+05LogNormal

1.005.00

2.05E+051.67E+05

0.170.17

Quantity Unit:

Each

Each

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

P₁₀P₅₀P₉₀

2.00E+002.35E+003.06E+00

2.35E+00LogNormal

1.005.00

2.59E+002.12E+00

0.300.30

P₁₀P₅₀P₉₀

1.30E+011.53E+012.00E+01

1.53E+01LogNormal

1.005.00

3.72E+017.66E+00

0.300.30

Quantity Unit:

Each

Each

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

NO

Not Applicable

0%0.00

0%0.00

NO

0%0.00

NO

Not Applicable

0%0.00

0%0.00

NO

0%0.00

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

None

Not Given

By User

By User

Not Given

2016-10-25 - Clarified repair.

Root Cost Multiplier:

1

Dispersion)	0%	0.00	0%	0.00	0%	0.00	0%	0.00	
Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.								
Date Created:	Not Given							Root Cost Multiplier:	1
Approved (YES / NO)?	By User								
Official (YES / NO) ?	By User								
Author:	Not Given								
Revisions:	2016-10-25 - Clarified repair.								

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D3067.012b

Control Panel - Capacity: all - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility only

Line 564

Costing is per unit.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

EA 1

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations



D3067.011a-DS1-1.JPG

Damage State Probability:

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

3

0.4

0.1

0.4

NO

NO

Superior

Average

Superior

Superior

Replace some components (relays, circuit boards).

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

3.20E+03

4.15E+03

5.15E+03

4.17E+03

Normal

1.00

5.00

4.57E+03

3.74E+03

0.18

0.18

Each

P₁₀

P₅₀

P₉₀

1.13E+00

1.46E+00

1.82E+00

1.46E+00

Normal

1.00

5.00

1.95E+00

9.76E-01

0.31

0.31

Each

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description


D3067.012c

Control Panel - Capacity: all - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/isolator & equipment
Costing is per unit.

Line 565

Construction Quality:	Normal - Designed for seismic loads but no special seismic certification			
Seismic Installation Conditions:	Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints			
Fragility Unit of Measure:	EA 1			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	3			
Damage State:	DS1	DS2	DS3	
Type of Damage State:	Mutually Exclusive	Mutually Exclusive	Mutually Exclusive	
DS Hierarchy	MutEx(DS1,DS2,DS3)			
Descriptions	Anchorage failure.	Anchorage failure & Equipment damaged beyond repair.	Damaged, Inoperative but anchorage is OK	

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		BLDG
Demand Location (floor above?)		No

Illustrations					
	none	D5010.011a-DS1-1.JPG	none		
Damage State Probability:	0.35	0.15	0.50		
Fragility Parameters					
Median Demand, θ :	By User	By User	By User		
Data dispersion, β_d :	User to Calculate	User to Calculate	User to Calculate		
Uncertainty, β_u :	User to Calculate	User to Calculate	User to Calculate		
Total Dispersion, β :	By User	By User	By User		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Superior				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Repair anchorage and concrete pad and remount equipment.	Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.	Replace some components (relays, circuit boards		

Long Lead Time (Yes / No)	NO	NO	NO		
Repair Costs:					
Repair Cost by Damage State:	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀
	3.00E+02 5.00E+02 6.50E+02	3.50E+03 4.65E+03 5.80E+03	3.20E+03 4.15E+03 5.15E+03		
Best fit mean:	4.83E+02	4.65E+03	4.17E+03		
Best Fit Distribution:	Normal	Normal	Normal		
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00	1.00 5.00	1.00 5.00		
Average Repair Cost (Min Qty, Max Qty)	5.50E+02 4.50E+02	5.12E+03 4.19E+03	4.57E+03 3.74E+03		
CV or beta (Min Qty, Max Qty)	0.28 0.28	0.19 0.19	0.18 0.18		
Quantity Unit:	Each	Each	Each		
Repair Time:					
Repair Time by Damage State:	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀
	1.06E-01 1.77E-01 2.29E-01	4.12E+00 5.47E+00 6.82E+00	3.76E+00 4.88E+00 6.06E+00		
Best fit mean:	1.77E-01	5.47E+00	4.88E+00		
Best Fit Distribution:	Normal	Normal	Normal		
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00	1.00 5.00	1.00 5.00		
Average Repair Time (Min Qty, Max Qty)	2.35E-01 1.18E-01	6.02E+00 4.92E+00	5.37E+00 4.39E+00		
CV or beta (Min Qty, Max Qty)	0.38 0.38	0.32 0.32	0.31 0.31		
Quantity Unit:	Each	Each	Each		
LifeSafety Hazard:					
Potential non-collapse casualties? (Yes / No)	NO	NO	NO		
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable	Not Applicable	Not Applicable		
Serious Injury (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00		
Loss of Life (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00		
Post-event Tagging Flag:	NO	NO	NO		
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00		
Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.				
Date Created:	Not Given			Root Cost Multiplier:	1
Approved (YES / NO)?	By User				
Official (YES / NO) ?	By User				
Author:	Not Given				
Revisions:	None				

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D4011.021a

Fire Sprinkler Water Piping - Horizontal Mains and Branches - Old Style Victaulic - Thin Wall Steel - No bracing, SDC A or B, PIPING FRAGILITY

Costing based upon 1000 ft segments of pipe, horizontal main and branches

Construction Quality:

Normal

Seismic Installation Conditions:

SDC A or B (no seismic design)

Fragility Unit of Measure:

LF 1000

Demand Parameter (unit):

Peak Floor Acceleration g

Number of Damage States:

2

Damage State:

DS1

DS2

Type of Damage State:

Sequential

Seq(DS1,DS2)

DS Hierarchy

Descriptions

Spraying & Dripping Leakage at joints - 0.02 leaks per 20 ft section of pipe.

Joints Break - Major Leakage - 0.02 breaks per 20 ft section of pipe.

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Illustrations

none

none

Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.1

Not Specified

Not Specified

0.4

NO

NO

Marginal

Marginal

Marginal

Marginal

Replace leaking joints and minor water cleanup.

Replace 20 ft section of pipe, joints and major water cleanup at leaking joints.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.50E+02

3.50E+02

8.00E+02

1.50E+03

2.65E+03

4.35E+03

3.48E+02

LogNormal

3.00

10.00

3.00

10.00

3.85E+02

3.15E+02

2.92E+03

2.39E+03

0.65

0.65

0.41

0.41

Each (1000 ft pipe)

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.75E-01

4.10E-01

9.40E-01

3.55E-01

6.25E-01

1.03E+00

4.10E-01

LogNormal

3.00

10.00

3.00

10.00

4.51E-01

3.69E-01

9.37E-01

3.13E-01

0.70

0.70

0.48

0.48

Each (1000 ft pipe)

Each (1000 ft pipe)

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

0%

0.00

NO

YES

0%

0.00

25%

0.50

One failure is expected per 1000 feet of pipe. Allowance included for MEP modifications for repair.

Not Given

By User

By User

Not Given

2011-08-24 Negative probability below 0.5 g - overlap deemed acceptable. 2016-10-25 Clarification of cost added.

Root Cost Multiplier:

50

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D4011.024a

Fire Sprinkler Water Piping - Horizontal Mains and Branches - Old Style Victaulic - Thin Wall Steel - with designed bracing, SDC D, E, or F (OSHDP or sim), PIPING FRAGILIT

Line 569

Costing based upon 1000 ft segments of pipe, horizontal main and branches

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Special Regulation (e.g. OSHPD) for sprinkler installations

SDC D,E,F (high seismic design)

LF 1000

Peak Floor Acceleration

g

2

DS1

DS2

Sequential

Seq(DS1,DS2)

Spraying & Dripping Leakage at joints - 0.02 leaks per 20 ft section of pipe.

Joints Break - Major Leakage - 0.02 breaks per 20 ft section of pipe.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO

Yes

Illustrations

Damage State Probability:

1.00

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.9

Not Specified

Not Specified

0.4

3.4

Not Specified

Not Specified

0.4

NO

NO

Marginal

Marginal

Marginal

Marginal

Replace leaking joints and minor water cleanup.

Replace 20 ft section of pipe, joints and major water cleanup at leaking joints.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.50E+02

3.50E+02

8.00E+02

1.50E+03

2.65E+03

4.35E+03

3.48E+02

LogNormal

3.00

10.00

3.00

10.00

3.85E+02

3.15E+02

2.92E+03

2.39E+03

0.65

0.65

0.41

0.41

Each (1000 ft pipe)

Each (1000 ft pipe)

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.75E-01

4.10E-01

9.40E-01

3.55E-01

6.25E-01

1.03E+00

4.10E-01

LogNormal

3.00

10.00

3.00

10.00

4.51E-01

3.69E-01

9.37E-01

3.13E-01

0.70

0.70

0.48

0.48

Each (1000 ft pipe)

Each (1000 ft pipe)

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

0%

0.00

NO

YES

0%

0.00

25%

0.50

One failure is expected per 1000 feet of pipe. Allowance included for MEP modifications for repair.

Not Given

By User

By User

Not Given

2016-10-25 Clarification of cost added.

Root Cost Multiplier:

50

Line 570

Fire Sprinkler Drop Standard Threaded Steel - Dropping into unbraced lay-in tile SOFT ceiling - 6 ft. long drop maximum, SDC A or B
Costing per 100 units, Standard threaded steel drop, 6 ft. long drop maximum

Spraying & Dripping Leakage at drop joints - 0.01 leaks per drop.

Drop Joints Break - Major Leakage - 0.01
breaks per drop.

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

none	none			
------	------	--	--	--

1.00

Repair Description

Replace sprinkler drops and minor water cleanup at broken joints.

Replace sprinkler drops and major water cleanup at broken joints

NO

Author:

One failure is expected

0%	0.00
----	------

One failure is expected per 100 units. Allowance included for MEP modifications for repair.

Not Given

By User

By User

Not Given
0010 10 0

2016-10-25 Clarification of cost added.

Root Cost Multiplier: 100

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D4011.032a

Fire Sprinkler Drop Standard Threaded Steel - Dropping into unbraced lay-in tile SOFT ceiling - 6 ft. long drop maximum, SDC C

Costing per 100 units, Standard threaded steel drop, 6 ft. long drop maximum

Line 571

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

SDC C (low seismic design)

EA 100

Peak Floor Acceleration

g

2

DS1

DS2

Sequential

Seq(DS1,DS2)

Spraying & Dripping Leakage at drop joints - 0.01 leaks per drop.

Drop Joints Break - Major Leakage - 0.01 breaks per drop.

Illustrations

none

none

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.00

1.00

0.75

Not Specified

Not Specified

0.4

0.95

Not Specified

Not Specified

0.4

NO

NO

Marginal

Marginal

Marginal

Marginal

Replace sprinkler drops and minor water cleanup at broken joints.

Replace sprinkler drops and major water cleanup at broken joints

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Time:

LifeSafety Hazard:

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.50E+02

5.00E+02

8.50E+02

3.50E+02

5.00E+02

8.50E+02

5.26E+02

LogNormal

2.00

5.00

2.00

5.00

5.50E+02

4.50E+02

5.50E+02

0.37

0.37

5.50E+02

4.50E+02

5.50E+02

0.37

0.37

100 Units

100 Units

1.20E-01

1.80E-01

3.00E-01

4.10E-01

5.90E-01

1.00E+00

5.90E-01

LogNormal

2.00

5.00

2.00

5.00

2.39E-01

1.21E-01

6.49E-01

5.31E-01

0.44

0.44

0.44

0.44

100 Units

100 Units

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

0%

0.00

One failure is expected per 100 units. Allowance included for MEP modifications for repair.

Not Given

By User

By User

Not Given

2016-10-25 Clarification of cost added.

Root Cost Multiplier:

100

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D4011.033a

Fire Sprinkler Drop Standard Threaded Steel - Dropping into unbraced lay-in tile SOFT ceiling - 6 ft. long drop maximum, SDC D, E, or F

Costing per 100 units, Standard threaded steel drop, 6 ft. long drop maximum

Line 572

Quantity Rounding

Round Qty?

NO

Allow sum by floor or building?

NO

Demand Location (floor above?)

Yes

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

SDC D,E,F (high seismic design)

EA 100

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Spraying & Dripping Leakage at drop joints - 0.01 leaks per drop.

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

0.95

Not Specified

Not Specified

0.4

NO

NO

Marginal

Marginal

Marginal

Marginal

Replace sprinkler drops and minor water cleanup at broken joints.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Time:

LifeSafety Hazard:

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

3.50E+02

5.00E+02

8.50E+02

2.00

5.00

5.50E+02

4.50E+02

0.37

0.37

100 Units

P₁₀

P₅₀

P₉₀

4.10E-01

5.90E-01

1.00E+00

2.00

5.00

6.49E-01

5.31E-01

0.44

0.44

100 Units

NO

Not Applicable

0%

0.00

NO

0%

0.00

One failure is expected per 100 units. Allowance included for MEP modifications for repair.

Not Given

By User

By User

Not Given

2016-10-25 Clarification of cost added.

Root Cost Multiplier:

100

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D4011.041a

Fire Sprinkler Drop Standard Threaded Steel - Dropping into unbraced lay-in tile HARD ceiling - 6 ft. long drop maximum, SDC A or B

Line 574

Costing per 100 units, Standard threaded steel drop, 6 ft. long drop maximum

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

SDC A or B (no seismic design)

EA 100

Peak Floor Acceleration

2

DS1

Sequential

Seq(DS1,DS2)

Spraying & Dripping Leakage at drop joints - 0.01 leaks per drop.

DS2

Sequential

Drop Joints Break - Major Leakage - 0.01 breaks per drop.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO

Yes

Illustrations

none

none

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.00

1.00

0.55

Not Specified

Not Specified

0.4

0.95

Not Specified

Not Specified

0.4

NO

NO

Marginal

Marginal

Marginal

Marginal

Replace sprinkler drops and minor water cleanup at broken joints.

Replace sprinkler drops and major water cleanup at broken joints

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.50E+02

5.00E+02

8.50E+02

3.50E+02

5.00E+02

8.50E+02

5.26E+02

LogNormal

2.00

5.00

5.50E+02

4.50E+02

0.37

0.37

100 Units

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

4.10E-01

5.90E-01

1.00E+00

8.00E-02

1.20E-01

2.00E-01

5.90E-01

LogNormal

2.00

5.00

6.49E-01

5.31E-01

0.44

0.44

100 Units

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

NO

NO

0%

0.00

One failure is expected per 100 units. Allowance included for MEP modifications for repair.

Not Given

By User

By User

Not Given

2016-10-25 Clarification of cost added.

Root Cost Multiplier:

100

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D4011.042a

Fire Sprinkler Drop Standard Threaded Steel - Dropping into unbraced lay-in tile HARD ceiling - 6 ft. long drop maximum, SDC C

Costing per 100 units, Standard threaded steel drop, 6 ft. long drop maximum

Line575

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal

SDC C (low seismic design)

EA 100

Peak Floor Acceleration

2

DS1

Sequential

Seq(DS1,DS2)

Spraying & Dripping Leakage at drop joints - 0.01 leaks per drop.

DS2

Sequential

Drop Joints Break - Major Leakage - 0.01 breaks per drop.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO

Yes

Illustrations

none

none

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.00

0.55

Not Specified

Not Specified

0.4

NO

NO

Marginal

Marginal

Marginal

Marginal

Replace sprinkler drops and minor water cleanup at broken joints.

1.00

0.95

Not Specified

Not Specified

0.4

Replace sprinkler drops and major water cleanup at broken joints

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.50E+02

5.00E+02

8.50E+02

3.50E+02

5.00E+02

8.50E+02

5.26E+02

LogNormal

2.00

5.00

5.50E+02

0.37

100 Units

4.10E-01

5.90E-01

1.00E+00

8.00E-02

1.20E-01

2.00E-01

5.90E-01

LogNormal

2.00

5.00

6.49E-01

0.44

100 Units

NO

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

One failure is expected per 100 units. Allowance included for MEP modifications for repair.

Not Given

By User

By User

Not Given

2016-10-25 Clarification of cost added.

Root Cost Multiplier:

100

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

D4011.053a

Fire Sprinkler Drop Standard Threaded Steel - Dropping into braced lay-in tile SOFT ceiling - 6 ft. long drop maximum, SDC D, E, or F
Costing per 100 units, Standard threaded steel drop, 6 ft. long drop maximum

Line 576

Construction Quality:	Normal					<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above)?Yes</div>
Seismic Installation Conditions:	SDC D,E,F (high seismic design)					
Fragility Unit of Measure:	EA 100					
Demand Parameter (unit):	Peak Floor Accelerationg					
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Spraying & Dripping Leakage at drop joints - 0.01 leaks per drop.		Drop joints Break - Major Leakage - 0.01 breaks per drop.			

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations

Damage State Probability:	none	none			
	1.00	1.00			
Fragility Parameters					
Median Demand, θ :	1.5	2.25			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β_t :	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Marginal				
Documentation Quality	Marginal				
Rationality	Marginal				
Consequence Functions					
Repair Description	Replace sprinkler drops and minor water cleanup at broken joints.		Replace sprinkler drops and major water cleanup at broken joints		

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	
Repair Cost by Damage State:	3.50E+02	5.00E+02	8.50E+02	3.50E+02	5.00E+02	8.50E+02										
Best fit mean:	5.26E+02			5.26E+02												
Best Fit Distribution:	LogNormal			LogNormal												
Quantity Plateau (Min Qty, Max Qty)	2.00		5.00	2.00		5.00										
Average Repair Cost (Min Qty, Max Qty)	5.50E+02		4.50E+02	5.50E+02		4.50E+02										
CV or beta (Min Qty, Max Qty)	0.37		0.37	0.37		0.37										
Quantity Unit:	100 Units			100 Units												
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	
Repair Time by Damage State:	4.10E-01	5.90E-01	1.00E+00	8.00E-02	1.20E-01	2.00E-01										
Best fit mean:	5.90E-01			1.20E-01												
Best Fit Distribution:	LogNormal			LogNormal												
Quantity Plateau (Min Qty, Max Qty)	2.00		5.00	2.00		5.00										
Average Repair Time (Min Qty, Max Qty)	6.49E-01		5.31E-01	1.79E-01		6.12E-02										
CV or beta (Min Qty, Max Qty)	0.44		0.44	0.44		0.44										
Quantity Unit:	100 Units			100 Units												
LifeSafety Hazard:																
Potential non-collapse casualties? (Yes / No)	NO						NO									
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable						Not Applicable									
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00										
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00										
Post-event Tagging Flag:	NO						NO									
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	0%		0.00										

Comments: One failure is expected per 100 units. Allowance included for MEP modifications for repair.

Date Created: Not Given

Root Cost Multiplier: 100

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

By User

By User

Not Given

2016-10-25 Clarification of cost added.

Line 577

Fire Sprinkler Drop Standard Threaded Steel - Dropping into braced lay-in tile SOFT ceiling - 6 ft. long drop maximum, SDC D, E, or F (OSHDP or sim)
Costing per 100 units, Standard threaded steel drop, 6 ft. long drop maximum

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

DS1	DS2			
Sequential	Sequential			
Seq(DS1,DS2)				
Spraying & Dripping Leakage at drop joints - 0.01 leaks per drop.	Drop joints Break - Major Leakage - 0.01 breaks per drop.			

none	none			
1.00	1.00			

Damage State Probability:		1.00	1.00		
Fragility Parameters					
Median Demand, θ :	1.9	3			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_{θ} :	Not Specified	Not Specified			
Total Dispersion, β:	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Marginal				
Documentation Quality	Marginal				
Rationality	Marginal				
Consequence Functions					
Repair Description	Replace sprinkler drops and minor water cleanup at broken joints.	Replace sprinkler drops and major water cleanup at broken joints			

Long Lead Time (Yes / No)	NO	NO
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Repair Costs:	P ₁₀ P ₅₀ P ₉₀			P ₁₀ P ₅₀ P ₉₀			P ₁₀ P ₅₀ P ₉₀			P ₁₀ P ₅₀ P ₉₀			P ₁₀ P ₅₀ P ₉₀		
Repair Cost by Damage State:	3.50E+02	5.00E+02	8.50E+02	3.50E+02	5.00E+02	8.50E+02									
Best fit mean:	5.26E+02			5.26E+02											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	2.00		5.00	2.00		5.00									
Average Repair Cost (Min Qty, Max Qty)	5.50E+02		4.50E+02	5.50E+02		4.50E+02									
CV or beta (Min Qty, Max Qty)	0.37		0.37	0.37		0.37									
Quantity Unit:	100 Units			100 Units											
Repair Time:	P ₁₀ P ₅₀ P ₉₀			P ₁₀ P ₅₀ P ₉₀			P ₁₀ P ₅₀ P ₉₀			P ₁₀ P ₅₀ P ₉₀			P ₁₀ P ₅₀ P ₉₀		
Repair Time by Damage State:	4.10E-01	5.90E-01	1.00E+00	8.00E-02	1.20E-01	2.00E-01									
Best fit mean:	5.90E-01			1.20E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	2.00		5.00	2.00		5.00									
Average Repair Time (Min Qty, Max Qty)	6.49E-01		5.31E-01	1.79E-01		6.12E-02									
CV or beta (Min Qty, Max Qty)	0.44		0.44	0.44		0.44									
Quantity Unit:	100 Units			100 Units											
LifeSafety Hazard:	NO			NO											
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										

Comments:	One failure is expected per 100 units. Allowance included for MEP modifications for repair.		
Date Created:	Not Given	Root Cost Multiplier:	100
Approved (YES / NO)?	By User		
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	2016-10-25 Clarification of cost added.		

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D4011.064a

Fire Sprinkler Drop Standard Threaded Steel - Dropping into braced lay-in tile HARD ceiling - 6 ft. long drop maximum, SDC D, E, or F (OSHDP or sim)

Costing per 100 units, Standard threaded steel drop, 6 ft. long drop maximum

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Special Regulation (e.g. OSHPD) for sprinkler installations

SDC D,E,F (high seismic design)

EA 100

Peak Floor Acceleration

g

2

DS1

DS2

Sequential

Seq(DS1,DS2)

Spraying & Dripping Leakage at drop joints - 0.01 leaks per drop.

Drop Joints Break - Major Leakage - 0.01 breaks per drop.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

NO

NO

Yes

Illustrations

none

none

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.00

1.1

Not Specified

Not Specified

0.4

NO

NO

Marginal

Marginal

Marginal

Marginal

Replace sprinkler drops and minor water cleanup at broken joints.

Replace sprinkler drops and major water cleanup at broken joints

1.00

2.25

Not Specified

Not Specified

0.4

NO

NO

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.50E+02

5.00E+02

8.50E+02

3.50E+02

5.00E+02

8.50E+02

5.26E+02

LogNormal

2.00

5.00

2.00

5.00

5.50E+02

4.50E+02

5.50E+02

4.50E+02

0.37

0.37

0.37

0.37

100 Units

100 Units

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.20E-01

1.80E-01

3.00E-01

4.10E-01

5.90E-01

1.00E+00

5.90E-01

LogNormal

2.00

5.00

2.00

5.00

2.39E-01

1.21E-01

6.49E-01

5.31E-01

0.44

0.44

0.44

0.44

100 Units

100 Units

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

NO

NO

0%

0.00

0%

0.00

One failure is expected per 100 units. Allowance included for MEP modifications for repair.

Not Given

By User

By User

Not Given

2016-10-25 Clarification of cost added.

Root Cost Multiplier:

100

FEMA P-58 Fragility Specification

NISTIR Classification D4011.071a
NISTIR Name Fire Sprinkler Drop Standard Threaded Steel - No Ceiling - 6 ft. long drop maximum, SDC A or B
Description Costing per 100 units, Standard threaded steel drop, 6 ft. long drop maximum

Line 580

Construction Quality:	Normal					<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above)?Yes</div>	
Seismic Installation Conditions:	SDC A, B (no seismic design)						
Fragility Unit of Measure:	EA 100						
Demand Parameter (unit):	Peak Floor Accelerationg						
Number of Damage States:	2						
Damage State:	DS1		DS2				
Type of Damage State:	Sequential		Sequential				
DS Hierarchy	Seq(DS1,DS2)						
Descriptions	Spraying & Dripping Leakage at drop joints - 0.01 leaks per drop.			Drop Joints Break - Major Leakage - 0.01 breaks per drop.			

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations					
	none	none			
Damage State Probability:	1.00	1.00			

Fragility Parameters					
Median Demand, θ :	1.5	2.25			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Marginal				
Documentation Quality	Marginal				
Rationality	Marginal				
Consequence Functions					
Repair Description	Replace sprinkler drops and minor water cleanup at broken joints.		Replace sprinkler drops and major water cleanup at broken joints		

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.50E+02	5.00E+02	8.50E+02	3.50E+02	5.00E+02	8.50E+02									
Best fit mean:	5.26E+02			5.26E+02											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	2.00		5.00	2.00		5.00									
Average Repair Cost (Min Qty, Max Qty)	5.50E+02		4.50E+02	5.50E+02		4.50E+02									
CV or beta (Min Qty, Max Qty)	0.37		0.37	0.37		0.37									
Quantity Unit:	100 Units			100 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.20E-01	1.80E-01	3.00E-01	4.10E-01	5.90E-01	1.00E+00									
Best fit mean:	1.80E-01			5.90E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	2.00		5.00	2.00		5.00									
Average Repair Time (Min Qty, Max Qty)	2.39E-01		1.21E-01	6.49E-01		5.31E-01									
CV or beta (Min Qty, Max Qty)	0.44		0.44	0.44		0.44									
Quantity Unit:	100 Units			100 Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00										
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00										
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00										

Comments: One failure is expected per 100 units. Allowance included for MEP modifications for repair.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2016-10-25 Clarification of cost added.
Root Cost Multiplier: 100

FEMA P-58 Fragility Specification

NISTIR Classification D4011.072a
NISTIR Name Fire Sprinkler Drop Standard Threaded Steel - No Ceiling - 6 ft. long drop maximum, SDC C
Description Costing per 100 units, Standard threaded steel drop, 6 ft. long drop maximum

Line 581

Construction Quality:	Normal				<div>Quantity RoundingRound Qty?NO Allow sum by floor or building?NO Demand Location (floor above)?Yes</div>
Seismic Installation Conditions:	SDC C (low seismic design)				
Fragility Unit of Measure:	EA 100				
Demand Parameter (unit):	Peak Floor Accelerationg				
Number of Damage States:	2				
Damage State:	DS1		DS2		
Type of Damage State:	Sequential		Sequential		
DS Hierarchy	Seq(DS1,DS2)				
Descriptions	Spraying & Dripping Leakage at drop joints - 0.01 leaks per drop.		Drop Joints Break - Major Leakage - 0.01 breaks per drop.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations					
	none	none			
Damage State Probability:	1.00	1.00			

Fragility Parameters					
Median Demand, θ :	1.5	2.25			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Marginal				
Documentation Quality	Marginal				
Rationality	Marginal				
Consequence Functions					
Repair Description	Replace sprinkler drops and minor water cleanup at broken joints.		Replace sprinkler drops and major water cleanup at broken joints		

Long Lead Time (Yes / No) NO NO

Repair Costs:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Cost by Damage State:	3.50E+02	5.00E+02	8.50E+02	3.50E+02	5.00E+02	8.50E+02									
Best fit mean:	5.26E+02			5.26E+02											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	2.00 5.00			2.00 5.00											
Average Repair Cost (Min Qty, Max Qty)	5.50E+02 4.50E+02			5.50E+02 4.50E+02											
CV or beta (Min Qty, Max Qty)	0.37 0.37			0.37 0.37											
Quantity Unit:	100 Units			100 Units											
Repair Time:	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
Repair Time by Damage State:	1.20E-01	1.80E-01	3.00E-01	4.10E-01	5.90E-01	1.00E+00									
Best fit mean:	1.80E-01			5.90E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	2.00 5.00			2.00 5.00											
Average Repair Time (Min Qty, Max Qty)	2.39E-01 1.21E-01			6.49E-01 5.31E-01											
CV or beta (Min Qty, Max Qty)	0.44 0.44			0.44 0.44											
Quantity Unit:	100 Units			100 Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0% 0.00			0% 0.00											
Loss of Life (Median, Dispersion)	0% 0.00			0% 0.00											
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00			0% 0.00											

Comments: One failure is expected per 100 units. Allowance included for MEP modifications for repair.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2016-10-25 Clarification of cost added.

Root Cost Multiplier: 100

FEMA P-58 Fragility Specification

NISTIR Classification D4011.073a
NISTIR Name Fire Sprinkler Drop Standard Threaded Steel - No Ceiling - 6 ft. long drop maximum, SDC D, E, or F
Description Costing per 100 units, Standard threaded steel drop, 6 ft. long drop maximum

Line 582

Construction Quality:	Normal					<div>Quantity RoundingRound Qty?NO</div> <div>Allow sum by floor or building?NO</div> <div>Demand Location (floor above)?Yes</div>
Seismic Installation Conditions:	SDC D,E,F (high seismic design)					
Fragility Unit of Measure:	EA 100					
Demand Parameter (unit):	Peak Floor Accelerationg					
Number of Damage States:	2					
Damage State:	DS1		DS2			
Type of Damage State:	Sequential		Sequential			
DS Hierarchy	Seq(DS1,DS2)					
Descriptions	Spraying & Dripping Leakage at drop joints - 0.01 leaks per drop.		Drop Joints Break - Major Leakage - 0.01 breaks per drop.			

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		Yes

Illustrations					
	none	none			
Damage State Probability:	1.00	1.00			

Fragility Parameters					
Median Demand, θ :	2.6	3			
Data dispersion, β_d :	Not Specified	Not Specified			
Uncertainty, β_u :	Not Specified	Not Specified			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Marginal				
Data Relevance	Marginal				
Documentation Quality	Marginal				
Rationality	Marginal				
Consequence Functions					
Repair Description	Replace sprinkler drops and minor water cleanup at broken joints.		Replace sprinkler drops and major water cleanup at broken joints		

Long Lead Time (Yes / No) NO NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	3.50E+02	5.00E+02	8.50E+02	3.50E+02	5.00E+02	8.50E+02									
Best fit mean:	5.26E+02			5.26E+02											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	2.00		5.00	2.00		5.00									
Average Repair Cost (Min Qty, Max Qty)	5.50E+02		4.50E+02	5.50E+02		4.50E+02									
CV or beta (Min Qty, Max Qty)	0.37		0.37	0.37		0.37									
Quantity Unit:	100 Units			100 Units											
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	4.10E-01	5.90E-01	1.00E+00	8.00E-02	1.20E-01	2.00E-01									
Best fit mean:	5.90E-01			1.20E-01											
Best Fit Distribution:	LogNormal			LogNormal											
Quantity Plateau (Min Qty, Max Qty)	2.00		5.00	2.00		5.00									
Average Repair Time (Min Qty, Max Qty)	6.49E-01		5.31E-01	1.79E-01		6.12E-02									
CV or beta (Min Qty, Max Qty)	0.44		0.44	0.44		0.44									
Quantity Unit:	100 Units			100 Units											
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO											
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable											
Serious Injury (Median, Dispersion)	0%		0.00	0%		0.00									
Loss of Life (Median, Dispersion)	0%		0.00	0%		0.00									
Post-event Tagging Flag:	NO			NO											
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00	0%		0.00									

Comments: One failure is expected per 100 units. Allowance included for MEP modifications for repair.
Date Created: Not Given
Approved (YES / NO)? By User
Official (YES / NO) ? By User
Author: Not Given
Revisions: 2016-10-25 Clarification of cost added.
Root Cost Multiplier: 100

Comments:	One failure is expected per 100 units. Allowance included for MEP modifications for repair.		
Date Created:	Not Given		
Approved (YES / NO)?	By User		
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	2016-10-25 Clarification of cost added.		
		Root Cost Multiplier:	100

Line 584

Transformer/primary service - Capacity: <100 kVA - Unanchored equipment that is not vibration isolated - Equipment fragility only
Costing is per unit and is based upon 75 kVA.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		BLDG
Demand Location (floor above?)		No

Number of Damage States:	1
Damage State:	DS1
Type of Damage State:	Sequential
DS Hierarchy	Seq(DS1)
Descriptions	Damaged, inoperative.

Illustrations

none
1.00

Superior
Average
Superior
Superior

Service and repair existing transformer.
Transformer tower removed, repaired
offsite, and reinstalled.

Long Lead Time (Yes / No) NO

[illegible]

Comments:	None
Date Created:	Not Given
Approved (YES / NO)?	By User
Official (YES / NO) ?	By User
Author:	Not Given
Revisions:	2016-10-25 Clarification of cost added.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5011.011b

Transformer/primary service - Capacity: 100 to <350 kVA - Unanchored equipment that is not vibration isolated - Equipment fragility only

Line 585

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Unanchored equipment that is not vibration isolated

KV 250

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

YES

BLDG

No

Illustrations

none

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.00

1.01

0.6

0.1

0.6

NO

NO

Superior

Average

Superior

Superior

Service and repair existing transformer.

Transformer tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Time:

LifeSafety Hazard:

Casualty-affected Planar Area (sf)

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

2.05E+04

2.43E+04

3.23E+04

2.05E+04

2.43E+04

3.23E+04

LogNormal

1.00

5.00

2.67E+04

2.18E+04

0.18

0.18

Each

P₁₀

P₅₀

P₉₀

3.62E+00

4.28E+00

5.70E+00

4.28E+00

5.70E+00

LogNormal

1.00

5.00

7.13E+00

2.14E+00

0.31

0.31

Each

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

None

Not Given

By User

By User

Not Given

2016-10-25 Clarification of cost added.

Root Cost Multiplier:

1

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5011.013a

Transformer/primary service - Capacity: <100 kVA - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragility

Line 588

Costing is per unit and is based upon 75 kVA.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

KV 75

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

MutEx(DS1,DS2)

Anchorage failure.

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

D5011.011a-DS1-1.JPG

Damage State Probability:

0.70

0.30

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β_t :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User

User to Calculate

User to Calculate

By User

NO

NO

Superior

Average

Superior

Superior

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Transformer tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

5.00E+02

1.00E+03

1.70E+03

6.60E+03

8.58E+03

1.15E+04

9.59E+02

LogNormal

1.00

5.00

1.10E+03

9.00E+02

0.45

0.45

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

5.88E-01

1.18E+00

2.00E+00

7.76E+00

1.01E+01

1.35E+01

1.18E+00

LogNormal

1.00

5.00

1.29E+00

1.06E+00

0.52

0.52

Each

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

NO

NO

0%

0.00

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

2016-10-25 Clarification of cost added.

Root Cost Multiplier:

1

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.		
Date Created:	Not Given	Root Cost Multiplier:	1
Approved (YES / NO)?	By User		
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	2016-10-25 Clarification of cost added.		

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5011.013d

Transformer/primary service - Capacity: 100 to <350 kVA - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

Costing is per unit and is based upon 250 kVa.

Line 591

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

KV 250

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

MutEx(DS1,DS2)

Anchorage failure.

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations



none

D5011.011a-DS1-1.JPG

Damage State Probability:

0.70

0.30

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β_t :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User

User to Calculate

User to Calculate

By User

NO

NO

Superior

Average

Superior

Superior

Repair anchorage and concrete pad and remount equipment.

By User

User to Calculate

User to Calculate

By User

NO

NO

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Transformer tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

8.00E+02

1.50E+03

2.40E+03

2.13E+04

2.58E+04

3.47E+04

1.57E+03

Normal

1.00

5.00

1.00

5.00

1.65E+03

1.35E+03

2.83E+04

2.32E+04

0.40

0.40

0.20

0.20

Each

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

7.65E-01

1.43E+00

2.29E+00

3.05E+00

3.69E+00

4.98E+00

1.43E+00

Normal

1.00

5.00

1.00

5.00

1.58E+00

1.29E+00

6.15E+00

1.85E+00

0.47

0.47

0.32

0.32

Each

Each

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

0%

0.00

NO

NO

0%

0.00

0%

0.00

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5011.013e

Transformer/primary service - Capacity: 100 to <350 kVA - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment f

Line 592

Costing is per unit and is based upon 250 kVa.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

KV 250

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

Damage State Probability:

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

3.05

0.6

0.1

0.5

NO

NO

Superior

Average

Superior

Superior

Service and repair existing transformer.

Transformer tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.05E+04

2.43E+04

3.23E+04

2.52E+04

LogNormal

1.00

5.00

2.67E+04

2.18E+04

0.18

0.18

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.94E+00

3.48E+00

4.63E+00

3.48E+00

LogNormal

1.00

5.00

5.80E+00

1.74E+00

0.31

0.31

Each

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

None

Not Given

By User

By User

Not Given

2016-10-25 Clarification of cost added.

Root Cost Multiplier:

1

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.		
Date Created:	Not Given	Root Cost Multiplier:	1
Approved (YES / NO)?	By User		
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	2016-10-25 Clarification of cost added.		

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5011.013j

Transformer/primary service - Capacity: 750 to 1500 kVA - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

Costing is per unit and is based upon 1000 kVA.

Line 597

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

KV 1000

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

MutEx(DS1,DS2)

Anchorage failure.

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations



none

D5011.011a-DS1-1.JPG

Damage State Probability:

0.70

0.30

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β_t :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User

User to Calculate

User to Calculate

By User

NO

NO

Superior

Average

Superior

Superior

Repair anchorage and concrete pad and remount equipment.

By User

User to Calculate

User to Calculate

By User

NO

NO

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Transformer tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.60E+03

2.40E+03

3.40E+03

4.91E+04

5.94E+04

7.82E+04

2.36E+03

6.10E+04

1.00

5.00

1.00

5.00

2.64E+03

2.16E+03

6.53E+04

5.35E+04

0.29

0.29

0.19

0.19

Each

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.53E+00

2.29E+00

3.25E+00

3.29E+00

3.97E+00

5.23E+00

2.29E+00

3.97E+00

1.00

5.00

1.00

5.00

2.52E+00

2.06E+00

9.65E+00

1.99E+00

0.38

0.38

0.31

0.31

Each

Each

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

0%

0.00

NO

NO

0%

0.00

0%

0.00

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5011.013I

Transformer/primary service - Capacity: 750 to 1500 kVA - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined a

Costing is per unit and is based upon 1000 kVA.

Line 599

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

KV 1000

Peak Floor Acceleration

g

3

DS1

Mutually Exclusive

MutEx(DS1,DS2,DS3)

Anchorage failure.

DS2

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

DS3

Mutually Exclusive

Damaged, Inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations



Damage State Probability:

0.35

0.15

0.50

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β_t :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User

User to Calculate

User to Calculate

By User

NO

NO

Superior

Average

Superior

Superior

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad. Transformer tower removed, repaired offsite, and reinstalled.

Service and repair existing transformer. Transformer tower removed, repaired offsite, and reinstalled.

Long Lead Time (Yes / No)

NO

YES

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.60E+03

2.40E+03

3.40E+03

4.91E+04

5.94E+04

7.82E+04

4.75E+04

5.70E+04

7.48E+04

2.36E+03

LogNormal

1.00

5.00

1.00

5.00

1.00

5.00

2.64E+03

2.16E+03

6.53E+04

5.35E+04

6.27E+04

5.13E+04

0.29

0.29

0.19

0.19

0.18

0.18

Each

Each

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.53E+00

2.29E+00

3.25E+00

3.29E+00

3.97E+00

5.23E+00

3.18E+00

3.81E+00

5.01E+00

2.29E+00

LogNormal

1.00

5.00

1.00

5.00

1.00

5.00

2.52E+00

2.06E+00

9.65E+00

1.99E+00

9.26E+00

1.91E+00

0.38

0.38

0.31

0.31

0.31

0.31

Each

Each

Each

NO

NO

NO

Not Applicable

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

0%

0.00

NO

NO

NO

0%

0.00

0%

0.00

0%

0.00

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

2016-10-25 Clarification of cost added.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.013a

Motor Control Center - Capacity: all - Unanchored equipment that is not vibration isolated - Equipment fragility only

Costing is per unit.

Line 600

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Unanchored equipment that is not vibration isolated

EA 1

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

Damage State Probability:

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

0.73

0.45

0.1

0.45

NO

NO

Superior

Average

Superior

Superior

Replace equipment.

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau

(Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau

(Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties?

(Yes / No)

Casualty-affected Planar Area (sf)

per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

3.20E+03

4.15E+03

5.15E+03

4.17E+03

Normal

1.00

5.00

4.57E+03

3.74E+03

0.18

0.18

Each

P₁₀

P₅₀

P₉₀

1.13E+00

1.46E+00

1.82E+00

1.46E+00

Normal

1.00

5.00

1.95E+00

9.76E-01

0.31

0.31

Each

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.		
Date Created:	Not Given	Root Cost Multiplier:	1
Approved (YES / NO)?	By User		
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	None		

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.013d

Motor Control Center - Capacity: all - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/isolator & e

Costing is per unit.

Line 603

Construction Quality:Normal - Designed for seismic loads but no special seismic certification

Seismic Installation Conditions:Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

Fragment Unit of Measure:EA 1

Demand Parameter (unit):Peak Floor Accelerationg

Number of Damage States:3

Damage State:DS1DS2DS3

Type of Damage State:Mutually ExclusiveMutually ExclusiveMutually Exclusive

DS HierarchyMutEx(DS1,DS2,DS3)

DescriptionsAnchorage failure.
Anchorage failure & Equipment damaged beyond repair.
Damaged, Inoperative but anchorage is OK.

Quantity RoundingRound Qty?YES

Allow sum by floor or building?BLDG

Demand Location (floor above?)No

Illustrations					
	none	D5010.011a-DS1-1.JPG	none		
Damage State Probability:	0.35	0.15	0.50		

Fragility Parameters					
Median Demand, θ :	By User	By User	By User		
Data dispersion, β_d :	User to Calculate	User to Calculate	User to Calculate		
Uncertainty, β_u :	User to Calculate	User to Calculate	User to Calculate		
Total Dispersion, β :	By User	By User	By User		

Correlation (Yes / No)NO

Directionality (Yes / No)NO

Quality Ratings

Data QualitySuperior

Data RelevanceAverage

Documentation QualitySuperior

RationalitySuperior

Consequence Functions

Repair Description

If anchored repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad if anchored.

Replace equipment.

Long Lead Time (Yes / No)	NO	NO	NO		
Repair Costs:	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀
Repair Cost by Damage State:	3.00E+025.00E+026.50E+02	3.50E+034.65E+035.80E+03	3.20E+034.15E+035.15E+03		
Best fit mean:	4.83E+02	4.65E+03	4.17E+03		
Best Fit Distribution:	Normal	Normal	Normal		
Quantity Plateau (Min Qty, Max Qty)	1.005.00	1.005.00	1.005.00		
Average Repair Cost (Min Qty, Max Qty)	5.50E+024.50E+02	5.12E+034.19E+03	4.57E+033.74E+03		
CV or beta (Min Qty, Max Qty)	0.280.28	0.190.19	0.180.18		
Quantity Unit:	Each	Each	Each		
Repair Time:	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀	P ₁₀ P ₅₀ P ₉₀
Repair Time by Damage State:	3.53E-015.88E-017.65E-01	8.24E-011.09E+001.36E+00	7.53E-019.77E-011.21E+00		
Best fit mean:	5.88E-01	1.09E+00	9.77E-01		
Best Fit Distribution:	Normal	Normal	Normal		
Quantity Plateau (Min Qty, Max Qty)	1.005.00	1.005.00	1.005.00		
Average Repair Time (Min Qty, Max Qty)	6.47E-015.29E-01	1.64E+005.47E-01	1.46E+004.88E-01		
CV or beta (Min Qty, Max Qty)	0.380.38	0.320.32	0.310.31		
Quantity Unit:	Each	Each	Each		
LifeSafety Hazard:					
Potential non-collapse casualties? (Yes / No)	NO	NO	NO		
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable	Not Applicable	Not Applicable		
Serious Injury (Median, Dispersion)	0%0.00	0%0.00	0%0.00		
Loss of Life (Median, Dispersion)	0%0.00	0%0.00	0%0.00		
Post-event Tagging Flag:	NO	NO	NO		
Unsafe Placard Trigger (Median, Dispersion)	0%0.00	0%0.00	0%0.00		

Comments:User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Date Created:Not Given

Approved (YES / NO)?By User

Official (YES / NO)?By User

Author:Not Given

Revisions:None

Root Cost Multiplier:1

Root Cost Multiplier: 1

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.023a

Low Voltage Switchgear - Capacity: 100 to <350 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragil

Line 608

Costing is per unit and is based upon 225 Amp.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

AP 225

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

MutEx(DS1,DS2)

Anchorage failure.

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

FLR

Demand Location (floor above?)

No

Illustrations

none

none

Damage State Probability:

0.70

0.30

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β_t :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

NO

NO

Superior

Average

Superior

Superior

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.00E+02

5.00E+02

6.50E+02

8.50E+03

9.78E+03

1.27E+04

4.83E+02

Normal

1.00

5.00

5.50E+02

4.50E+02

0.28

0.28

Each

Each

3.53E-01

5.88E-01

7.65E-01

2.00E+00

2.30E+00

2.99E+00

5.88E-01

Normal

1.00

5.00

6.47E-01

5.29E-01

0.38

0.38

Each

Each

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

NO

NO

0%

0.00

0%

0.00

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.023b

Low Voltage Switchgear - Capacity: 100 to <350 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragil

Line 609

Costing is per unit and is based upon 225 Amp.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

AP 225

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

FLR

Demand Location (floor above?)

No

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.00

2.4

0.4

0.1

0.4

NO

NO

Superior

Average

Superior

Superior

Replace fiberglass insulator supporting the vertical bus bars in the rear of the switchgear assembly

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

8.20E+03

9.28E+03

1.21E+04

9.71E+03

1.00

5.00

1.02E+04

8.35E+03

0.16

0.16

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.93E+00

2.18E+00

2.84E+00

2.18E+00

1.00

5.00

3.27E+00

1.09E+00

0.30

0.30

Each

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.023c

Low Voltage Switchgear - Capacity: 100 to <350 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchoring

Costing is per unit and is based upon 225 Amp.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

AP 225

Peak Floor Acceleration

g

3

DS1

DS2

DS3

Mutually Exclusive

Mutually Exclusive

Mutually Exclusive

MutEx(DS1,DS2,DS3)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Damaged, Inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

FLR

Demand Location (floor above?)

No

Illustrations

Damage State Probability:

0.35

0.15

0.50

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β_t :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User

User to Calculate

User to Calculate

By User

NO

NO

Superior

Average

Superior

Superior

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Replace fiberglass insulator supporting the vertical bus bars in the rear of the switchgear assembly

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.00E+02

5.00E+02

6.50E+02

8.50E+03

9.78E+03

1.27E+04

8.20E+03

9.28E+03

1.21E+04

4.83E+02

Normal

1.00

5.00

5.50E+02

0.28

4.50E+02

0.28

1.08E+04

0.16

8.80E+03

0.16

1.02E+04

0.16

8.35E+03

0.16

Each

Each

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.53E-01

5.88E-01

7.65E-01

2.00E+00

2.30E+00

2.99E+00

1.93E+00

2.18E+00

2.84E+00

5.88E-01

Normal

1.00

5.00

6.47E-01

0.38

5.29E-01

0.38

3.45E+00

0.30

1.15E+00

0.30

3.27E+00

0.30

1.09E+00

0.30

Each

Each

Each

NO

NO

NO

Not Applicable

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

NO

NO

NO

0%

0.00

0%

0.00

0%

0.00

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.023d

Low Voltage Switchgear - Capacity: 350 to <750 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragil

Costing is per unit and is based upon 400 Amp.

Line 611

Construction Quality:Normal - Designed for seismic loads but no special seismic certification

Seismic Installation Conditions:Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

Quantity RoundingRound Qty? YES

Fragility Unit of Measure:AP 400

Allow sum by floor or building? FLR

Demand Parameter (unit):Peak Floor Accelerationg

Demand Location (floor above?) No

Number of Damage States:2

Damage State:DS1DS2

Type of Damage State:Mutually ExclusiveMutually Exclusive

DS HierarchyMutEx(DS1,DS2)

DescriptionsAnchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Illustrations					
	none	none			
	0.70	0.30			

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User

User to Calculate

User to Calculate

By User

NO

NO

Superior

Average

Superior

Superior

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

5.00E+02

8.00E+02

1.40E+03

1.52E+04

1.81E+04

2.41E+04

8.20E+02

LogNormal

1.00

5.00

1.00

5.00

8.80E+02

7.20E+02

1.99E+04

1.63E+04

0.41

0.41

0.19

0.19

Each

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

5.88E-01

9.41E-01

1.65E+00

2.68E+00

3.19E+00

4.25E+00

9.41E-01

LogNormal

1.00

5.00

1.00

5.00

1.04E+00

8.47E-01

5.32E+00

1.60E+00

0.48

0.48

0.31

0.31

Each

Each

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

0%

0.00

NO

NO

0%

0.00

0%

0.00

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Root Cost Multiplier:1

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.		
Date Created:	Not Given	Root Cost Multiplier:	1
Approved (YES / NO)?	By User		
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	None		

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.023g

Low Voltage Switchgear - Capacity: 750 to <1200 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage frag

Line 614

Costing is per unit and is based upon 800 Amp.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

AP 800

Peak Floor Acceleration

2

DS1

DS2

Mutually Exclusive

MutEx(DS1,DS2)

Anchorage failure.

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

YES

FLR

No

Illustrations

none

none

Damage State Probability:

0.70

0.30

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β_t :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User

User to Calculate

User to Calculate

By User

NO

NO

Superior

Average

Superior

Superior

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau

(Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau

(Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

9.00E+02

1.20E+03

2.00E+03

2.53E+04

3.08E+04

4.10E+04

1.28E+03

LogNormal

1.00

5.00

1.00

5.00

1.32E+03

1.08E+03

0.34

0.34

3.39E+04

2.77E+04

0.19

0.19

Each

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.06E+00

1.41E+00

2.35E+00

2.98E+00

3.62E+00

4.82E+00

1.41E+00

LogNormal

1.00

5.00

1.00

5.00

1.55E+00

1.27E+00

0.42

0.42

7.25E+00

1.81E+00

0.32

0.32

Each

Each

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

NO

NO

0%

0.00

0%

0.00

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.023h

Low Voltage Switchgear - Capacity: 750 to <1200 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment frag
Costing is per unit and is based upon 800 Amp.

Line 615

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

AP 800

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

YES

FLR

No

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

2.4

0.4

0.1

0.4

NO

NO

Superior

Average

Superior

Superior

Replace fiberglass insulator supporting the vertical bus bars in the rear of the switchgear assembly

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.44E+04

2.96E+04

2.96E+04

2.79E+04

Normal

1.00

5.00

3.26E+04

2.66E+04

0.07

0.07

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.87E+00

3.48E+00

3.48E+00

3.48E+00

Normal

1.00

5.00

6.96E+00

1.74E+00

0.26

0.26

Each

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.023i

Low Voltage Switchgear - Capacity: 750 to <1200 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anch

Costing is per unit and is based upon 800 Amp.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

AP 800

Peak Floor Acceleration

g

3

DS1

DS2

DS3

Mutually Exclusive

Mutually Exclusive

Mutually Exclusive

MutEx(DS1,DS2,DS3)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Damaged, Inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

YES

FLR

No

Illustrations

Damage State Probability:

0.35

0.15

0.50

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β_t :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User

User to Calculate

User to Calculate

By User

NO

NO

Superior

Average

Superior

Superior

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Replace fiberglass insulator supporting the vertical bus bars in the rear of the switchgear assembly

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

9.00E+02

1.20E+03

2.00E+03

2.53E+04

3.08E+04

4.10E+04

2.44E+04

2.96E+04

2.96E+04

1.28E+03

LogNormal

1.00

5.00

1.00

5.00

1.00

5.00

1.32E+03

1.08E+03

3.39E+04

2.77E+04

3.26E+04

2.66E+04

0.34

0.34

0.19

0.19

0.07

0.07

Each

Each

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.06E+00

1.41E+00

2.35E+00

2.98E+00

3.62E+00

4.82E+00

2.87E+00

3.48E+00

3.48E+00

1.41E+00

LogNormal

1.00

5.00

1.00

5.00

1.00

5.00

1.55E+00

1.27E+00

7.25E+00

1.81E+00

6.96E+00

1.74E+00

0.42

0.42

0.32

0.32

0.26

0.26

Each

Each

Each

NO

NO

NO

Not Applicable

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

NO

NO

NO

0%

0.00

0%

0.00

0%

0.00

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.023j

Low Voltage Switchgear - Capacity: 1200 to 2000 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage frag

Line 617

Costing is per unit and is based upon 1600 Amp.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

AP 1600

Peak Floor Acceleration

2

DS1

DS2

Mutually Exclusive

MutEx(DS1,DS2)

Anchorage failure.

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

YES

FLR

No

Illustrations

none

none

0.70

0.30

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β_t :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User

User to Calculate

User to Calculate

By User

NO

NO

Superior

Average

Superior

Superior

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Long Lead Time (Yes / No)

NO

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

9.00E+02

1.20E+03

2.00E+03

4.38E+04

5.26E+04

6.95E+04

1.28E+03

5.43E+04

1.00

5.00

1.00

5.00

1.32E+03

1.08E+03

5.79E+04

4.73E+04

0.34

0.34

0.19

0.19

Each

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.06E+00

1.41E+00

2.35E+00

3.61E+00

4.33E+00

5.72E+00

1.41E+00

4.33E+00

1.00

5.00

1.00

5.00

1.55E+00

1.27E+00

1.05E+01

2.17E+00

0.42

0.42

0.31

0.31

Each

Each

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

NO

NO

0%

0.00

0%

0.00

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.023k

Low Voltage Switchgear - Capacity: 1200 to 2000 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment frag
Costing is per unit and is based upon 1600 Amp.

Line 618

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

AP 1600

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

YES

FLR

No

Illustrations

none

1.00

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

2.4

0.4

0.1

0.4

NO

NO

Superior

Average

Superior

Superior

Replace fiberglass insulator supporting the vertical bus bars in the rear of the switchgear assembly

Long Lead Time (Yes / No)

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

4.29E+04

5.14E+04

5.14E+04

4.86E+04

Normal

1.00

5.00

5.65E+04

4.63E+04

0.07

0.07

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.53E+00

4.23E+00

4.23E+00

4.23E+00

Normal

1.00

5.00

1.03E+01

2.12E+00

0.26

0.26

Each

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.023I

Low Voltage Switchgear - Capacity: 1200 to 2000 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anch

Line 619

Costing is per unit and is based upon 1600 Amp.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

AP 1600

Peak Floor Acceleration

g

3

DS1

DS2

DS3

Mutually Exclusive

Mutually Exclusive

Mutually Exclusive

MutEx(DS1,DS2,DS3)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Damaged, Inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

YES

FLR

No

Illustrations

Damage State Probability:

0.35

0.15

0.50

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β_t :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User

User to Calculate

User to Calculate

By User

NO

NO

Superior

Average

Superior

Superior

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Replace fiberglass insulator supporting the vertical bus bars in the rear of the switchgear assembly

Long Lead Time (Yes / No)

NO

YES

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

9.00E+02

1.20E+03

2.00E+03

4.38E+04

5.26E+04

6.95E+04

4.29E+04

5.14E+04

5.14E+04

1.28E+03

LogNormal

1.00

5.00

1.00

5.00

1.00

5.00

1.32E+03

1.08E+03

5.79E+04

4.73E+04

5.65E+04

4.63E+04

0.34

0.34

0.19

0.19

0.07

0.07

Each

Each

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.06E+00

1.41E+00

2.35E+00

3.61E+00

4.33E+00

5.72E+00

3.53E+00

4.23E+00

4.23E+00

1.41E+00

LogNormal

1.00

5.00

1.00

5.00

1.00

5.00

1.55E+00

1.27E+00

1.05E+01

2.17E+00

1.03E+01

2.12E+00

0.42

0.42

0.31

0.31

0.26

0.26

Each

Each

Each

NO

NO

NO

Not Applicable

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

NO

NO

NO

0%

0.00

0%

0.00

0%

0.00

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Root Cost Multiplier:

1

Root Cost Multiplier: 1

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.031c

Distribution Panel - Capacity: 750 to <1200 Amp - Unanchored equipment that is not vibration isolated - Equipment fragility only

Costing is per unit and is based upon 800 Amp.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Unanchored equipment that is not vibration isolated

AP 800

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

Allow sum by floor or building?


Demand Location (floor above?)

YES

BLDG

No

Illustrations



D5012.031b-DS1-1.JPG

Damage State Probability:

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

2.16

0.4

0.25

0.45

NO

NO

Superior

Average

Superior

Superior

Replace equipment

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO)?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.44E+04

2.96E+04

2.96E+04

2.79E+04

Normal

1.00

5.00

3.85E+04

2.66E+04

0.07

0.07

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

2.87E+00

3.48E+00

3.48E+00

3.48E+00

Normal

1.00

5.00

1.39E+01

1.74E+00

0.26

0.26

Each

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.031d

Distribution Panel - Capacity: 1200 to 2000 Amp - Unanchored equipment that is not vibration isolated - Equipment fragility only

Costing is per unit and is based upon 1600 Amp.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Unanchored equipment that is not vibration isolated

AP 1600

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

YES

BLDG

No

Illustrations



D5012.031b-DS1-1.JPG

Damage State Probability:

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

2.16

0.4

0.25

0.45

NO

NO

Superior

Average

Superior

Superior

Replace equipment

Long Lead Time (Yes / No)

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

4.29E+04

5.14E+04

5.14E+04

4.86E+04

Normal

1.00

5.00

6.68E+04

4.63E+04

0.07

0.07

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.53E+00

4.23E+00

4.23E+00

4.23E+00

Normal

1.00

5.00

2.24E+01

2.12E+00

0.26

0.26

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO)?

Author:

Revisions:

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

None

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.033b

Distribution Panel - Capacity: 100 to <350 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility on Costing is per unit and is based upon 225 Amp.

Line 625

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

AP 225

Peak Floor Acceleration

g

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations



D5012.031b-DS1-1.JPG

Damage State Probability:

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

3.05

0.4

0.1

0.4

NO

NO

Superior

Average

Superior

Superior

Replace equipment

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

8.20E+03

9.28E+03

1.21E+04

LogNormal

1.00

5.00

1.11E+04

7.42E+03

0.16

0.16

Each

P₁₀

P₅₀

P₉₀

2.17E+00

2.46E+00

3.19E+00

2.46E+00

LogNormal

1.00

5.00

4.91E+00

1.23E+00

0.30

0.30

Each

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.033c

Distribution Panel - Capacity: 100 to <350 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/
Costing is per unit and is based upon 225 Amp.

Line 626

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification
Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints
AP 225
Peak Floor Acceleration g
3
DS1
Mutually Exclusive
MutEx(DS1,DS2,DS3)
Anchorage failure.

DS2
Mutually Exclusive
Anchorage failure & Equipment
damaged beyond repair.

DS3
Mutually Exclusive
Damaged, Inoperative but anchorage is
OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

none

none

Damage State Probability:

0.35

0.15

0.50

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User

User to Calculate

User to Calculate

By User

NO

NO

Superior

Average

Superior

Superior

Repair anchorage and concrete pad (if
floor mounted and wall if wall
mounted) and remount equipment.

Replace equipment in addition to
repairing anchorage and concrete pad if
floor mounted or wall if wall mounted.

Replace equipment.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau
(Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau
(Min Qty, Max Qty)

Average Repair Time (Min Qty, Max
Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties?
(Yes / No)

Casualty-affected Planar Area (sf)
per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median,
Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.00E+02

5.00E+02

6.50E+02

8.50E+03

9.78E+03

1.27E+04

8.20E+03

9.28E+03

1.21E+04

4.83E+02

Normal

1.00

5.00

1.00

5.00

1.00

5.00

6.00E+02

4.00E+02

1.17E+04

7.82E+03

1.11E+04

7.42E+03

0.28

0.28

0.16

0.16

0.16

0.16

Each

Each

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

3.97E-01

6.62E-01

8.60E-01

2.25E+00

2.59E+00

3.36E+00

2.17E+00

2.46E+00

3.19E+00

6.62E-01

Normal

1.00

5.00

1.00

5.00

1.00

5.00

7.94E-01

5.29E-01

5.18E+00

1.29E+00

4.91E+00

1.23E+00

0.38

0.38

0.30

0.30

0.30

0.30

Each

Each

Each

NO

NO

NO

Not Applicable

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

NO

NO

NO

0%

0.00

0%

0.00

0%

0.00

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Root Cost Multiplier:

1

[illegible]

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.033e

Distribution Panel - Capacity: 350 to <750 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility on

Line 628

Costing is per unit and is based upon 400 Amp.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

AP 400

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

YES

BLDG

No

Illustrations



D5012.031b-DS1-1.JPG

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.00

3.05

0.4

0.1

0.4

NO

NO

Superior

Average

Superior

Superior

Replace equipment

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Time:

LifeSafety Hazard:

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO)?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

1.47E+04

1.73E+04

1.73E+04

P₁₀

P₅₀

P₉₀

1.64E+04

Normal

5.00

P₁₀

P₅₀

P₉₀

2.08E+04

1.38E+04

0.06

P₁₀

P₅₀

P₉₀

Each

Each

Each

P₁₀

P₅₀

P₉₀

2.92E+00

3.43E+00

3.43E+00

P₁₀

P₅₀

P₉₀

3.43E+00

Normal

5.00

P₁₀

P₅₀

P₉₀

8.01E+00

1.72E+00

0.26

P₁₀

P₅₀

P₉₀

NO

Not Applicable

0%

P₁₀

P₅₀

P₉₀

NO

0%

0%

P₁₀

P₅₀

P₉₀

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier: 1

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.		
Date Created:	Not Given	Root Cost Multiplier:	1
Approved (YES / NO)?	By User		
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	None		

[illegible]

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.033h

Distribution Panel - Capacity: 750 to <1200 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility o

Line 631

Costing is per unit and is based upon 800 Amp.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

AP 800

Peak Floor Acceleration

1

DS1

Sequential

Seq(DS1)

Damaged, inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

Allow sum by floor or building?


Demand Location (floor above?)

YES

BLDG

No

Illustrations



D5012.031b-DS1-1.JPG

Damage State Probability:

1.00

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

3.05

0.4

0.1

0.4

NO

NO

Superior

Average

Superior

Superior

Replace equipment

Long Lead Time (Yes / No)

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau

(Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau

(Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties?

(Yes / No)

Casualty-affected Planar Area (sf)

per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

2.44E+04

2.96E+04

2.96E+04

2.79E+04

Normal

1.00

5.00

3.55E+04

2.37E+04

0.07

0.07

Each

P₁₀

P₅₀

P₉₀

3.23E+00

3.92E+00

3.92E+00

3.92E+00

Normal

1.00

5.00

1.18E+01

1.96E+00

0.26

0.26

Each

NO

Not Applicable

0%

0.00

0%

0.00

NO

0%

0.00

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.033i

Distribution Panel - Capacity: 750 to <1200 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage

Costing is per unit and is based upon 800 Amp.

Construction Quality:

Normal - Designed for seismic loads but no special seismic certification

Seismic Installation Conditions:

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

Quantity Rounding

Round Qty?

YES

Fragility Unit of Measure:

AP 800

Allow sum by floor or building?

BLDG

Demand Parameter (unit):

Peak Floor Acceleration

g

Demand Location (floor above?)

No

Number of Damage States:

3

Damage State:

DS1

DS2

DS3

Type of Damage State:

Mutually Exclusive

Mutually Exclusive

Mutually Exclusive

DS Hierarchy

MutEx(DS1,DS2,DS3)

Descriptions

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Damaged, Inoperative but anchorage is OK.

Illustrations

Damage State Probability:

0.35

0.15

0.50

Fragility Parameters

Median Demand, θ :

By User

By User

By User

Data dispersion, β_d :

User to Calculate

User to Calculate

User to Calculate

Uncertainty, β_u :

User to Calculate

User to Calculate

User to Calculate

Total Dispersion, β :

By User

By User

By User

Correlation (Yes / No)

NO

Directionality (Yes / No)

NO

Quality Ratings

Data Quality

Superior

Data Relevance

Average

Documentation Quality

Superior

Rationality

Superior

Consequence Functions

Repair Description

Repair anchorage and concrete pad (if floor mounted and wall if wall mounted) and remount equipment.

Replace equipment in addition to repairing anchorage and concrete pad if floor mounted or wall if wall mounted.

Replace equipment.

Long Lead Time (Yes / No)

NO

NO

NO

Repair Costs:

Repair Cost by Damage State:

9.00E+02

1.20E+03

2.00E+03

2.53E+04

3.08E+04

4.10E+04

2.44E+04

2.96E+04

2.96E+04

Best fit mean:

1.28E+03

3.17E+04

2.79E+04

Best Fit Distribution:

LogNormal

LogNormal

Normal

Quantity Plateau (Min Qty, Max Qty)

1.00

5.00

1.00

5.00

1.00

5.00

Average Repair Cost (Min Qty, Max Qty)

1.44E+03

9.60E+02

3.70E+04

2.46E+04

3.55E+04

2.37E+04

CV or beta (Min Qty, Max Qty)

0.34

0.34

0.19

0.19

0.07

0.07

Quantity Unit:

Each

Each

Each

Repair Time:

Repair Time by Damage State:

1.19E+00

1.59E+00

2.65E+00

3.35E+00

4.08E+00

5.43E+00

3.23E+00

3.92E+00

3.92E+00

Best fit mean:

1.59E+00

4.08E+00

3.92E+00

Best Fit Distribution:

LogNormal

LogNormal

Normal

Quantity Plateau (Min Qty, Max Qty)

1.00

5.00

1.00

5.00

1.00

5.00

Average Repair Time (Min Qty, Max Qty)

1.91E+00

1.27E+00

1.22E+01

2.04E+00

1.18E+01

1.96E+00

CV or beta (Min Qty, Max Qty)

0.42

0.42

0.32

0.32

0.26

0.26

Quantity Unit:

Each

Each

Each

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

NO

NO

NO

Casualty-affected Planar Area (sf) per Normative Unit:

Not Applicable

Not Applicable

Not Applicable

Serious Injury (Median, Dispersion)

0%

0.00

0%

0.00

0%

0.00

Loss of Life (Median, Dispersion)

0%

0.00

0%

0.00

0%

0.00

Post-event Tagging Flag:

NO

NO

NO

Unsafe Placard Trigger (Median, Dispersion)

0%

0.00

0%

0.00

0%

0.00

Comments:

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

None

Root Cost Multiplier:

1

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.		
Date Created:	Not Given	Root Cost Multiplier:	1
Approved (YES / NO)?	By User		
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	None		

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5012.0331

Distribution Panel - Capacity: 1200 to 2000 Amp - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage

Costing is per unit and is based upon 1600 Amp.

Line 635

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

AP 1600

Peak Floor Acceleration

g

3

DS1

DS2

DS3

Mutually Exclusive

Mutually Exclusive

Mutually Exclusive

MutEx(DS1,DS2,DS3)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Damaged, Inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β_t :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

0.35

0.15

0.50

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

NO

NO

Superior

Average

Superior

Superior

Repair anchorage and concrete pad (if floor mounted and wall if wall mounted) and remount equipment.

Replace equipment in addition to repairing anchorage and concrete pad if floor mounted or wall if wall mounted.

Replace equipment.

Long Lead Time (Yes / No)

NO

YES

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

9.00E+02

1.20E+03

2.00E+03

4.38E+04

5.26E+04

6.95E+04

4.29E+04

5.14E+04

5.14E+04

1.28E+03

LogNormal

1.00

5.00

1.00

5.00

1.00

5.00

1.44E+03

9.60E+02

6.31E+04

4.21E+04

6.17E+04

4.11E+04

0.34

0.34

0.19

0.19

0.07

0.07

Each

Each

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.19E+00

1.59E+00

2.65E+00

4.06E+00

4.87E+00

6.44E+00

3.97E+00

4.76E+00

4.76E+00

1.59E+00

LogNormal

1.00

5.00

1.00

5.00

1.00

5.00

1.91E+00

1.27E+00

1.88E+01

2.44E+00

1.84E+01

2.38E+00

0.42

0.42

0.31

0.31

0.26

0.26

Each

Each

Each

NO

NO

NO

Not Applicable

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

NO

NO

NO

0%

0.00

0%

0.00

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Root Cost Multiplier:

1

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5092.013b

Battery Rack - Capacity: all - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility only

Costing is per unit.

Line 638

Construction Quality:Normal - Designed for seismic loads but no special seismic certification

Seismic Installation Conditions:Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

Fragility Unit of Measure:EA 1

Demand Parameter (unit):Peak Floor Accelerationg

Number of Damage States:3

Damage State:DS1DS2DS3

Type of Damage State:SimultaneousSimultaneousSimultaneous

DS HierarchySimul(DS1,DS2,DS3)

DescriptionsDamaged, inoperative but anchorage is OK. Batteries fall, crack cases, dislodge conductors, or are otherwise damaged. Batteries spill battery acid. Battery rack collapses.

Quantity Rounding	Round Qty?	YES
	Allow sum by floor or building?	BLDG
Demand Location (floor above?)		No

Illustrations

Damage State Probability:	1.00	0.50	0.10		
Fragility Parameters					
Median Demand, θ :	2.32	2.32	2.32		
Data dispersion, β_d :	0.2	0.20	0.2		
Uncertainty, β_u :	0.1	0.1	0.1		
Total Dispersion, β :	0.2	0.2	0.2		
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Superior				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Replace batteries.	Clean up spilled acid.	Replace battery rack.		

Long Lead Time (Yes / No) YES YES YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.10E+04	1.20E+04	1.40E+04	4.00E+02	7.50E+02	9.00E+02	2.20E+03	3.15E+03	4.15E+03						
Best fit mean:	1.23E+04			6.83E+02			3.17E+03								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00						
Average Repair Cost (Min Qty, Max Qty)	1.44E+04		9.60E+03	9.00E+02		6.00E+02	3.78E+03		2.52E+03						
CV or beta (Min Qty, Max Qty)	0.10		0.10	0.29		0.29	0.24		0.24						
Quantity Unit:	Each			Each			Each								
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.46E+01	1.59E+01	1.85E+01	5.29E-01	9.93E-01	1.19E+00	2.91E+00	4.17E+00	5.49E+00						
Best fit mean:	1.59E+01			9.93E-01			4.17E+00								
Best Fit Distribution:	LogNormal			Normal			Normal								
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00						
Average Repair Time (Min Qty, Max Qty)	1.91E+01		1.27E+01	1.19E+00		7.94E-01	5.00E+00		3.34E+00						
CV or beta (Min Qty, Max Qty)	0.27		0.27	0.38		0.38	0.35		0.35						
Quantity Unit:	Each			Each			Each								
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO								
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable								
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Post-event Tagging Flag:	NO			NO			NO								
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00							
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5092.013c

Battery Rack - Capacity: all - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/isolator & equipmen

Costing is per unit.

Line 639

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

EA 1

Peak Floor Acceleration

g

5

DS1

Mutually Exclusive

MutEx(DS1,DS2,DS3,DS4,DS5)

Anchorage failure.

DS2

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

DS3

Mutually Exclusive

Equipment is damaged and inoperative.

DS4

Mutually Exclusive

Equipment is damaged and inoperative.

DS5

Mutually Exclusive

Equipment is damaged and inoperative.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

none

none

none

none

Damage State Probability:

0.35

0.15

0.15

0.25

0.10

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β_t :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User

User to Calculate

User to Calculate

By User

NO

NO

Superior

Average

Superior

Superior

Repair anchorage and concrete pad and remount equipment.

By User

User to Calculate

User to Calculate

By User

NO

NO

Superior

Average

Superior

Superior

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

By User

User to Calculate

User to Calculate

By User

NO

NO

Superior

Average

Superior

Superior

Replace batteries.

By User

User to Calculate

User to Calculate

By User

NO

NO

Superior

Average

Superior

Superior

Replace batteries and clean up acid.

By User

User to Calculate

User to Calculate

By User

NO

NO

Superior

Average

Superior

Superior

Replace rack including batteries and clean up acid.

Long Lead Time (Yes / No)

YES

YES

YES

YES

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

8.00E+02

1.00E+03

1.15E+03

1.40E+04

1.62E+04

1.93E+04

1.10E+04

1.20E+04

1.40E+04

1.14E+04

1.28E+04

1.49E+04

1.44E+04

1.69E+04

2.02E+04

9.83E+02

Normal

1.00

5.00

1.00

5.00

1.00

5.00

1.00

5.00

1.00

5.00

1.00

5.00

1.00

5.00

1.00

5.00

1.20E+03

8.00E+02

1.94E+04

1.29E+04

1.44E+04

9.60E+03

1.53E+04

1.02E+04

2.03E+04

1.35E+04

0.14

0.14

0.13

0.13

0.10

0.10

0.11

0.11

0.13

0.13

Each

Each

Each

Each

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.06E+00

1.32E+00

1.52E+00

1.85E+01

2.14E+01

2.55E+01

1.46E+01

1.59E+01

1.85E+01

1.51E+01

1.69E+01

1.97E+01

1.91E+01

2.24E+01

2.67E+01

1.32E+00

Normal

1.00

5.00

1.00

5.00

1.00

5.00

1.00

5.00

1.00

5.00

1.00

5.00

1.00

5.00

1.00

5.00

1.59E+00

1.06E+00

2.57E+01

1.71E+01

1.91E+01

1.27E+01

2.03E+01

1.35E+01

2.68E+01

1.79E+01

0.29

0.29

0.28

0.28

0.27

0.27

0.27

0.27

0.28

0.28

Each

Each

Each

Each

Each

NO

NO

NO

NO

NO

Not Applicable

Not Applicable

Not Applicable

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

0%

0.00

0%

0.00

0%

0.00

0%

0.00

0%

0.00

NO

NO

NO

NO

NO

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5092.021a

Battery Charger - Capacity: all - Unanchored equipment that is not vibration isolated - Equipment fragility only

Costing is per unit.

Line 640

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Unanchored equipment that is not vibration isolated

EA 1

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

Mutually Exclusive

MutEx(DS1,DS2)

Damaged, inoperative but anchorage is OK.

Damaged, inoperative but anchorage is OK.

Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

none

Damage State Probability:

0.50

0.50

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.07

0.4

0.1

0.4

NO

NO

Superior

Average

Superior

Superior

Service for intermittent voltage output or for blown surge suppressor.

Replace equipment.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

6.00E+02

8.00E+02

9.00E+02

1.02E+04

1.22E+04

1.42E+04

7.67E+02

Normal

1.00

5.00

1.00

5.00

9.60E+02

6.40E+02

1.46E+04

9.72E+03

0.15

0.15

0.13

0.13

Each

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

7.94E-01

1.06E+00

1.19E+00

1.35E+01

1.61E+01

1.87E+01

1.06E+00

Normal

1.00

5.00

1.00

5.00

1.27E+00

8.47E-01

1.93E+01

1.29E+01

0.29

0.29

0.28

0.28

Each

Each

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

NO

NO

0%

0.00

0%

0.00

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5092.023a

Battery Charger - Capacity: all - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragility only

Costing is per unit.

Line 641

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

EA 1

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

MutEx(DS1,DS2)

Anchorage failure.

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

none

none

Damage State Probability:

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

0.70

0.30

By User

User to Calculate

User to Calculate

By User

NO

NO

Superior

Average

Superior

Superior

Repair anchorage and concrete pad (if floor mounted and wall if wall mounted) and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad / wall.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Time:

LifeSafety Hazard:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

5.00E+02

7.00E+02

8.50E+02

P₁₀

P₅₀

P₉₀

1.07E+04

1.29E+04

1.50E+04

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

6.83E+02

Normal

1.00

5.00

1.00

5.00

7.70E+02

0.20

6.30E+02

0.20

1.41E+04

0.13

1.16E+04

0.13

Each

Each

P₁₀

P₅₀

P₉₀

6.62E-01

9.27E-01

1.13E+00

P₁₀

P₅₀

P₉₀

1.42E+01

1.70E+01

1.99E+01

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

9.27E-01

Normal

1.00

5.00

1.00

5.00

1.02E+00

0.32

8.34E-01

0.32

1.87E+01

0.28

1.53E+01

0.28

Each

Each

NO

Not Applicable

0%

0.00

NO

Not Applicable

0%

0.00

NO

0%

0.00

NO

0%

0.00

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier: 1

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

D5092.031a

Line 644

NISTIR Name

Diesel generator - Capacity: 100 to <350 kVA - Unanchored equipment that is not vibration isolated - Equipment fragility only

Description

Costing is per unit and is based upon 250 kVA.

Construction Quality:

Normal - Not designed for seismic loads

Seismic Installation Conditions:

Unanchored equipment that is not vibration isolated

Fragility Unit of Measure:

KV 250

Demand Parameter (unit):

Peak Floor Acceleration g

Number of Damage States:

4

Damage State:

DS1

DS2

DS3

DS4

Type of Damage State:

Mutually Exclusive

Mutually Exclusive

Mutually Exclusive

Mutually Exclusive

DS Hierarchy

MutEx(DS1,DS2,DS3,DS4)

Descriptions

Damaged, inoperative. Pipes and nozzles damaged.


Damaged, inoperative. Drive shaft misalignment.

Damaged, inoperative. Minor electrical damage, e.g., failed relay.

Damaged, inoperative. Exhaust line disconnected at expansion bellows.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		BLDG
Demand Location (floor above?)		No

Illustrations

				
D5092.031b-DS1-1.JPG	none	none	none	

Damage State Probability:

0.70

0.10

0.10

0.10

Fragility Parameters

Median Demand, θ :

0.9

0.9

0.9

0.9

Data dispersion, β_d :

0.4

0.60

0.6

0.6

Uncertainty, β_u :

0.1

0.1

0.1

0.1

Total Dispersion, β :

0.4

0.4

0.4

0.4

Correlation (Yes / No)

NO

Directionality (Yes / No)

NO

Quality Ratings

Data Quality

Average

Data Relevance

Average

Documentation Quality

Superior

Rationality

Superior

Consequence Functions

Repair Description

Repair fracture pipes and damaged nozzles.

Overhaul because of drive shaft misalignment.

Minor electrical repair e.g., replace relay.

Reconnect exhaust line.

Long Lead Time (Yes / No)

NO

NO

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.70E+02	2.00E+02	2.60E+02	2.13E+03	2.50E+03	3.25E+03	4.30E+02	5.00E+02	6.50E+02	4.30E+02	5.00E+02	6.50E+02			
Best fit mean:	2.07E+02			2.58E+03			5.19E+02			5.19E+02					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00	1.00		5.00			
Average Repair Cost (Min Qty, Max Qty)	2.20E+02		1.80E+02	3.25E+03		2.00E+03	6.00E+02		4.00E+02	6.00E+02		4.00E+02			
CV or beta (Min Qty, Max Qty)	0.17		0.17	0.17		0.17	0.17		0.17	0.17		0.17			
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.50E-01	1.77E-01	2.29E-01	1.88E+00	2.21E+00	2.87E+00	3.79E-01	4.41E-01	5.74E-01	3.79E-01	4.41E-01	5.74E-01			
Best fit mean:	1.77E-01			2.21E+00			4.41E-01			4.41E-01					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00	1.00		5.00			
Average Repair Time (Min Qty, Max Qty)	1.94E-01		1.59E-01	2.87E+00		1.76E+00	5.29E-01		3.53E-01	5.29E-01		3.53E-01			
CV or beta (Min Qty, Max Qty)	0.30		0.30	0.30		0.30	0.30		0.30	0.30		0.30			
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00				
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00				
Post-event Tagging Flag:	NO			NO			NO			NO					
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00				

Comments:

None

Date Created:

Not Given

Approved (YES / NO)?

By User

Official (YES / NO) ?

By User

Author:

Not Given

Revisions:

2011-08-24 DS2, DS3, DS4 median changed from 0.3 to 0.9 and beta changed from 0.6 to 0.4 in order to match D5092.031b,c,d.

Root Cost Multiplier: 1

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification


NISTIR Classification
NISTIR Name
Description

D5092.031d
Diesel generator - Capacity: 1200 to 2000 kVa - Unanchored equipment that is not vibration isolated - Equipment fragility only
Costing is per unit and is based upon 1500 kVa.

Line 647

Construction Quality:	Normal - Not designed for seismic loads			
Seismic Installation Conditions:	Unanchored equipment that is not vibration isolated			
Fragility Unit of Measure:	KV 1500			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	4			
Damage State:	DS1	DS2	DS3	DS4
Type of Damage State:	Mutually Exclusive		Mutually Exclusive	
DS Hierarchy	MutEx(DS1,DS2,DS3,DS4)		Mutually Exclusive	
Descriptions	MutEx(DS1,DS2,DS3,DS4) Damaged, inoperative. Pipes and nozzles damaged.		Damaged, inoperative. Drive shaft misalignment. Damaged, inoperative. Minor electrical damage, e.g., failed relay.	
			Damaged, inoperative. Exhaust line disconnected at expansion bellows.	

Illustrations



D5092.031b-DS1-1.JPG

Damage State Probability:	0.70	0.10	0.10	0.10
Fragility Parameters				
Median Demand, θ :	0.9	0.9	0.9	0.9
Data dispersion, β_d :	0.4	0.40	0.4	0.4
Uncertainty, β_u :	0.1	0.1	0.1	0.1
Total Dispersion, β :	0.4	0.4	0.4	0.4
Correlation (Yes / No)	NO			
Directionality (Yes / No)	NO			
Quality Ratings				
Data Quality	Average			
Data Relevance	Average			
Documentation Quality	Superior			
Rationality	Superior			
Consequence Functions				
Repair Description	Repair fracture pipes and damaged nozzles.	Overhaul because of drive shaft misalignment.	Minor electrical repair e.g., replace relay.	Reconnect exhaust line.

Long Lead Time (Yes / No)

YES YES YES YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.28E+03	1.50E+03	1.95E+03	8.50E+03	1.00E+04	1.30E+04	1.02E+03	1.20E+03	1.56E+03	1.02E+03	1.20E+03	1.56E+03			
Best fit mean:	1.55E+03			1.03E+04			1.24E+03			1.24E+03					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00	1.00		5.00			
Average Repair Cost (Min Qty, Max Qty)	1.95E+03		1.35E+03	1.30E+04		9.00E+03	1.56E+03		1.08E+03	1.56E+03		1.08E+03			
CV or beta (Min Qty, Max Qty)	0.17		0.17	0.17		0.17	0.17		0.17	0.17		0.17			
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.32E+00	1.54E+00	2.01E+00	8.75E+00	1.03E+01	1.34E+01	1.05E+00	1.24E+00	1.61E+00	1.05E+00	1.24E+00	1.61E+00			
Best fit mean:	1.54E+00			1.03E+01			1.24E+00			1.24E+00					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00	1.00		5.00			
Average Repair Time (Min Qty, Max Qty)	2.01E+00		1.39E+00	1.34E+01		9.26E+00	1.61E+00		1.11E+00	1.61E+00		1.11E+00			
CV or beta (Min Qty, Max Qty)	0.30		0.30	0.30		0.30	0.30		0.30	0.30		0.30			
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:	NO			NO			NO			NO					
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00				
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00				
Post-event Tagging Flag:	NO			NO			NO			NO					
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00				
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														
	Root Cost Multiplier: 1														

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5092.032a

Diesel generator - Capacity: 100 to <350 kVA - Vibration isolated equipment that is not snubbed or restrained - Anchorage fragility only

Costing is per unit and is based upon 250 kVA.

Line 648

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

KV 250

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

MutEx(DS1,DS2)

Anchorage failure.

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations



D5092.031a-DS1-1.JPG

none

Damage State Probability:

0.70

0.30

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β_t :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

NO

NO

Average

Average

Superior

Superior

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
5.00E+02	1.00E+03	1.70E+03	8.66E+04	1.02E+05	1.34E+05									
9.59E+02			1.06E+05											
LogNormal			LogNormal											
1.00		5.00	1.00		5.00									
1.30E+03		9.00E+02	1.33E+05		9.20E+04									
0.45		0.45	0.17		0.17									
Each			Each											
P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
4.41E-01	8.82E-01	1.50E+00	1.53E+01	1.80E+01	2.36E+01									
8.82E-01			1.80E+01											
LogNormal			LogNormal											
1.00		5.00	1.00		5.00									
1.15E+00		7.94E-01	4.51E+01		9.02E+00									
0.52		0.52	0.30		0.30									
Each			Each											
NO			NO											
Not Applicable			Not Applicable											
0%	0.00		0%	0.00										
0%	0.00		0%	0.00										
NO			NO											
0%	0.00		0%	0.00										

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Root Cost Multiplier: 1

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5092.032e

Diesel generator - Capacity: 350 to <750 kVA - Vibration isolated equipment that is not snubbed or restrained - Equipment fragility only

Costing is per unit and is based upon 500 kVA.

Line 652

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

KV 500

Peak Floor Acceleration

g

4

DS1

DS2

DS3

DS4

Mutually Exclusive

Mutually Exclusive

Mutually Exclusive

Mutually Exclusive

MutEx(DS1,DS2,DS3,DS4)

Damaged, inoperative but anchorage is OK. Pipes and nozzles damaged.

Damaged, inoperative but anchorage is OK. Drive shaft misalignment.

Damaged, inoperative but anchorage is OK. Minor electrical damage, e.g., failed relay.

Damaged, inoperative but anchorage is OK. Exhaust line disconnected at expansion bellows.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations

D5092.031b-DS1-1.JPG

none

none

none

Damage State Probability:

0.70

0.10

0.10

0.10

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

1.07

1.07

1.07

1.07

NO

NO

Average

Average

Superior

Superior

Repair fracture pipes and damaged nozzles.

Overhaul because of drive shaft misalignment.

Minor electrical repair e.g., replace relay.

Reconnect exhaust line.

Long Lead Time (Yes / No)

YES

YES

YES

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau

(Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Each

Each

Each

Each

Each

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau

(Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Each

Each

Each

Each

Each

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

NO

NO

NO

NO

Not Applicable

Not Applicable

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

0%

0.00

0%

0.00

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5092.032f

Diesel generator - Capacity: 350 to <750 kVA - Vibration isolated equipment that is not snubbed or restrained - Combined anchorage/isolator & equipment fragility

Costing is per unit and is based upon 500 kVA.

Line 653

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

KV 500

Peak Floor Acceleration

g

5

DS1

DS2

DS3

DS4

DS5

Mutually Exclusive

Mutually Exclusive

Mutually Exclusive

Mutually Exclusive

Mutually Exclusive

MutEx(DS1,DS2,DS3,DS4,DS5)

Anchorage failure.

Anchorage failure & Equipment damaged beyond repair.

Damaged, Inoperative but anchorage is OK

Equipment is damaged and inoperative but anchorage is OK.

Equipment is damaged and inoperative but anchorage is OK.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

YES

BLDG

No

Illustrations

D5092.031a-DS1-1.JPG

none

none

none

none

Damage State Probability:

0.35

0.15

0.40

0.05

0.05

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β_t :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User

User to Calculate

User to Calculate

By User

NO

NO

Average

Average

Superior

Superior

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Repair fracture pipes & damaged nozzles, and or reconnect exhaust line.

Overhaul because of drive shaft misalignment.

minor electrical repair e.g., replace relays.

Long Lead Time (Yes / No)

YES

YES

YES

YES

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P_{10}

P_{50}

P_{90}

8.00E+02

1.50E+03

2.40E+03

P_{10}

P_{50}

P_{90}

1.73E+05

2.05E+05

2.67E+05

P_{10}

P_{50}

P_{90}

3.40E+02

4.00E+02

5.20E+02

P_{10}

P_{50}

P_{90}

4.25E+03

5.00E+03

6.50E+03

P_{10}

P_{50}

P_{90}

6.80E+02

8.00E+02

1.04E+03

1.57E+03

Normal

1.00

5.00

1.95E+03

0.40

2.11E+05

LogNormal

1.00

5.00

2.66E+05

0.17

4.13E+02

LogNormal

1.00

5.00

5.20E+02

0.17

5.17E+03

LogNormal

1.00

5.00

6.50E+03

0.17

8.26E+02

LogNormal

1.00

5.00

1.04E+03

0.17

Each

Each

Each

Each

Each

P_{10}

P_{50}

P_{90}

8.24E-01

1.54E+00

2.47E+00

P_{10}

P_{50}

P_{90}

2.68E+01

3.16E+01

4.12E+01

P_{10}

P_{50}

P_{90}

3.50E-01

4.12E-01

5.35E-01

P_{10}

P_{50}

P_{90}

4.38E+00

5.15E+00

6.69E+00

P_{10}

P_{50}

P_{90}

7.00E-01

8.24E-01

1.07E+00

1.54E+00

Normal

1.00

5.00

2.01E+00

0.47

3.16E+01

LogNormal

1.00

5.00

9.47E+01

0.30

4.12E-01

LogNormal

1.00

5.00

5.35E-01

0.30

5.15E+00

LogNormal

1.00

5.00

6.69E+00

0.30

8.24E-01

LogNormal

1.00

5.00

1.07E+00

0.30

Each

Each

Each

Each

Each

NO

NO

NO

NO

NO

Not Applicable

Not Applicable

Not Applicable

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

0%

0.00

0%

0.00

0%

0.00

0%

0.00

0%

0.00

NO

NO

NO

NO

NO

0%

0.00

0%

0.00

0%

0.00

0%

0.00

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5092.032h

Diesel generator - Capacity: 750 to 1200 kVA - Vibration isolated equipment that is not snubbed or restrained - Equipment fragility only

Costing is per unit and is based upon 1000 kVA.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

KV 1000

Peak Floor Acceleration

g

4

DS1

DS2

DS3

DS4

Mutually Exclusive

Mutually Exclusive

Mutually Exclusive

Mutually Exclusive

MutEx(DS1,DS2,DS3,DS4)

Damaged, inoperative but anchorage is OK. Pipes and nozzles damaged.

Damaged, inoperative but anchorage is OK. Drive shaft misalignment.

Damaged, inoperative but anchorage is OK. Minor electrical damage, e.g., failed relay.

Damaged, inoperative but anchorage is OK. Exhaust line disconnected at expansion bellows.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations



D5092.031b-DS1-1.JPG

none

none

none

Damage State Probability:

0.70

0.10

0.10

0.10

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

NO

NO

Average

Average

Superior

Superior

Repair fracture pipes and damaged nozzles.

Overhaul because of drive shaft misalignment.

Minor electrical repair e.g., replace relay.

Reconnect exhaust line.

Long Lead Time (Yes / No)

YES

YES

YES

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

7.70E+02

9.00E+02

1.17E+03

6.80E+03

8.00E+03

1.04E+04

1.02E+03

1.20E+03

1.56E+03

1.02E+03

1.20E+03

1.56E+03

9.32E+02

LogNormal

1.00

5.00

1.00

5.00

1.00

5.00

1.00

5.00

9.90E+02

8.10E+02

1.04E+04

6.40E+03

1.44E+03

9.60E+02

1.44E+03

9.60E+02

0.17

0.17

0.17

0.17

0.17

0.17

0.17

0.17

Each

Each

Each

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

6.79E-01

7.94E-01

1.03E+00

6.00E+00

7.06E+00

9.18E+00

9.00E-01

1.06E+00

1.38E+00

9.00E-01

1.06E+00

1.38E+00

7.94E-01

LogNormal

1.00

5.00

1.00

5.00

1.00

5.00

1.00

5.00

8.74E-01

7.15E-01

9.18E+00

5.65E+00

1.27E+00

8.47E-01

1.27E+00

8.47E-01

0.30

0.30

0.30

0.30

0.30

0.30

0.30

0.30

Each

Each

Each

Each

NO

NO

NO

NO

Not Applicable

Not Applicable

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

0%

0.00

NO

NO

NO

NO

0%

0.00

0%

0.00

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5092.032k

Diesel generator - Capacity: 1200 to 2000 kVa - Vibration isolated equipment that is not snubbed or restrained - Equipment fragility only

Costing is per unit and is based upon 1500 kVa.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Not designed for seismic loads

Vibration isolated equipment that is not snubbed or restrained

KV 1500

Peak Floor Acceleration

g

4

DS1

DS2

DS3

DS4

Mutually Exclusive

Mutually Exclusive

Mutually Exclusive

Mutually Exclusive

MutEx(DS1,DS2,DS3,DS4)

Damaged, inoperative but anchorage is OK. Pipes and nozzles damaged.

Damaged, inoperative but anchorage is OK. Drive shaft misalignment.

Damaged, inoperative but anchorage is OK. Minor electrical damage, e.g., failed relay.

Damaged, inoperative but anchorage is OK. Exhaust line disconnected at expansion bellows.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations



D5092.031b-DS1-1.JPG

none

none

none

Damage State Probability:

0.70

0.10

0.10

0.10

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

NO

NO

Average

Average

Superior

Superior

Repair fracture pipes and damaged nozzles.

Overhaul because of drive shaft misalignment.

Minor electrical repair e.g., replace relay.

Reconnect exhaust line.

Long Lead Time (Yes / No)

YES

YES

YES

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.28E+03

1.50E+03

1.95E+03

8.50E+03

1.00E+04

1.30E+04

1.02E+03

1.20E+03

1.56E+03

1.02E+03

1.20E+03

1.56E+03

1.55E+03

LogNormal

1.00

5.00

1.00

5.00

1.00

5.00

1.00

5.00

1.95E+03

1.35E+03

1.30E+04

9.00E+03

1.56E+03

1.08E+03

1.56E+03

1.08E+03

0.17

0.17

0.17

0.17

0.17

0.17

0.17

0.17

Each

Each

Each

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.32E+00

1.54E+00

2.01E+00

8.75E+00

1.03E+01

1.34E+01

1.05E+00

1.24E+00

1.61E+00

1.05E+00

1.24E+00

1.61E+00

1.54E+00

LogNormal

1.00

5.00

1.00

5.00

1.00

5.00

1.00

5.00

2.01E+00

1.39E+00

1.34E+01

9.26E+00

1.61E+00

1.11E+00

1.61E+00

1.11E+00

0.30

0.30

0.30

0.30

0.30

0.30

0.30

0.30

Each

Each

Each

Each

NO

NO

NO

NO

Not Applicable

Not Applicable

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

0%

0.00

NO

NO

NO

NO

0%

0.00

0%

0.00

None

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Comments:	User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.		
Date Created:	Not Given	Root Cost Multiplier:	1
Approved (YES / NO)?	By User		
Official (YES / NO) ?	By User		
Author:	Not Given		
Revisions:	None		

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5092.033b

Diesel generator - Capacity: 100 to <350 kVA - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility only

Costing is per unit and is based upon 250 kVA.

Line 661

Construction Quality:	Normal - Designed for seismic loads but no special seismic certification			
Seismic Installation Conditions:	Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints			
Fragility Unit of Measure:	KV 250			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	4			
Damage State:	DS1	DS2	DS3	DS4
Type of Damage State:	Mutually Exclusive		Mutually Exclusive	
DS Hierarchy	MutEx(DS1,DS2,DS3,DS4)			
Descriptions	Damaged, inoperative but anchorage is OK. Pipes and nozzles damaged.	Damaged, inoperative but anchorage is OK. Drive shaft misalignment.	Damaged, inoperative but anchorage is OK. Minor electrical damage, e.g., failed relay.	Damaged, inoperative but anchorage is OK. Exhaust line disconnected at expansion bellows.

Quantity Rounding	Round Qty?	YES
	Allow sum by floor or building?	BLDG
Demand Location (floor above?)		No

Illustrations

Damage State Probability:					
	D5092.031b-DS1-1.JPG	none	none	none	
	0.70	0.10	0.10	0.10	
Fragility Parameters					
Median Demand, θ :	2	2	2	2	
Data dispersion, β_d :	0.2	0.20	0.2	0.2	
Uncertainty, β_u :	0.1	0.1	0.1	0.1	
Total Dispersion, β :	0.2	0.2	0.2	0.2	
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Average				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Repair fracture pipes and damaged nozzles.	Overhaul because of drive shaft misalignment.	Minor electrical repair e.g., replace relay.	Reconnect exhaust line.	

Long Lead Time (Yes / No)

Long Lead Time (Yes / No)	NO			NO			NO			NO					
Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.70E+02	2.00E+02	2.60E+02	2.13E+03	2.50E+03	3.25E+03	4.30E+02	5.00E+02	6.50E+02	4.30E+02	5.00E+02	6.50E+02			
Best fit mean:	2.07E+02			2.58E+03			5.19E+02			5.19E+02					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00	1.00		5.00			
Average Repair Cost (Min Qty, Max Qty)	2.60E+02		1.80E+02	3.25E+03		2.25E+03	6.50E+02		4.50E+02	6.50E+02		4.50E+02			
CV or beta (Min Qty, Max Qty)	0.17		0.17	0.17		0.17	0.17		0.17	0.17		0.17			
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.75E-01	2.06E-01	2.68E-01	2.19E+00	2.57E+00	3.35E+00	4.43E-01	5.15E-01	6.69E-01	4.43E-01	5.15E-01	6.69E-01			
Best fit mean:	2.06E-01			2.57E+00			5.15E-01			5.15E-01					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00	1.00		5.00			
Average Repair Time (Min Qty, Max Qty)	2.68E-01		1.85E-01	3.35E+00		2.32E+00	6.69E-01		4.63E-01	6.69E-01		4.63E-01			
CV or beta (Min Qty, Max Qty)	0.30		0.30	0.30		0.30	0.30		0.30	0.30		0.30			
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00				
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00				
Post-event Tagging Flag:	NO			NO			NO			NO					
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00				
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														
													Root Cost Multiplier:	1	

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5092.033d

Diesel generator - Capacity: 350 to <750 kVA - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragility only

Line 663

Costing is per unit and is based upon 500 kVA.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

KV 500

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

MutEx(DS1,DS2)

Anchorage failure.

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations



D5092.031a-DS1-1.JPG

none

0.30

Damage State Probability:

0.70

0.30

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β_t :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User

User to Calculate

User to Calculate

By User

NO

NO

Average

Average

Superior

Superior

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Long Lead Time (Yes / No)

YES

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

8.00E+02

1.50E+03

2.40E+03

1.73E+05

2.05E+05

2.67E+05

1.57E+03

Normal

1.00

5.00

1.95E+03

1.35E+03

0.40

0.40

Each

2.68E+01

3.16E+01

4.12E+01

1.54E+00

Normal

1.00

5.00

2.01E+00

1.39E+00

0.47

0.47

Each

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

NO

NO

0%

0.00

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5092.033e


Diesel generator - Capacity: 350 to <750 kVA - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility only

Costing is per unit and is based upon 500 kVA.

Line 664

Construction Quality:	Normal - Designed for seismic loads but no special seismic certification			
Seismic Installation Conditions:	Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints			
Fragility Unit of Measure:	KV 500			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	4			
Damage State:	DS1	DS2	DS3	DS4
Type of Damage State:	Mutually Exclusive		Mutually Exclusive	
DS Hierarchy	MutEx(DS1,DS2,DS3,DS4)			
Descriptions	Damaged, inoperative but anchorage is OK. Pipes and nozzles damaged.	Damaged, inoperative but anchorage is OK. Drive shaft misalignment.	Damaged, inoperative but anchorage is OK. Minor electrical damage, e.g., failed relay.	Damaged, inoperative but anchorage is OK. Exhaust line disconnected at expansion bellows.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		BLDG
Demand Location (floor above)?		No

Illustrations					
					
Damage State Probability:	0.70	0.10	0.10	0.10	
Fragility Parameters					
Median Demand, θ :	2	2	2	2	
Data dispersion, β_d :	0.2	0.20	0.2	0.2	
Uncertainty, β_u :	0.1	0.1	0.1	0.1	
Total Dispersion, β :	0.2	0.2	0.2	0.2	
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Average				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Repair fracture pipes and damaged nozzles.	Overhaul because of drive shaft misalignment.	Minor electrical repair e.g., replace relay.	Reconnect exhaust line.	

Long Lead Time (Yes / No)	YES	YES	YES	YES	
Repair Costs:	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}
Repair Cost by Damage State:	3.40E+02 4.00E+02 5.20E+02	4.25E+03 5.00E+03 6.50E+03	6.80E+02 8.00E+02 1.04E+03	6.80E+02 8.00E+02 1.04E+03	
Best fit mean:	4.13E+02	5.17E+03	8.26E+02	8.26E+02	
Best Fit Distribution:	LogNormal	LogNormal	LogNormal	LogNormal	
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00	1.00 5.00	1.00 5.00	1.00 5.00	
Average Repair Cost (Min Qty, Max Qty)	5.20E+02 0.17	6.50E+03 0.17	9.60E+02 0.17	9.60E+02 0.17	
CV or beta (Min Qty, Max Qty)	0.17	0.17	0.17	0.17	
Quantity Unit:	Each	Each	Each	Each	
Repair Time:	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}	P_{10} P_{50} P_{90}
Repair Time by Damage State:	4.50E-01 5.29E-01 6.88E-01	5.63E+00 6.62E+00 8.60E+00	9.00E-01 1.06E+00 1.38E+00	9.00E-01 1.06E+00 1.38E+00	
Best fit mean:	5.29E-01	6.62E+00	1.06E+00	1.06E+00	
Best Fit Distribution:	LogNormal	LogNormal	LogNormal	LogNormal	
Quantity Plateau (Min Qty, Max Qty)	1.00 5.00	1.00 5.00	1.00 5.00	1.00 5.00	
Average Repair Time (Min Qty, Max Qty)	6.88E-01 0.30	8.60E+00 0.30	1.27E+00 0.30	1.27E+00 0.30	
CV or beta (Min Qty, Max Qty)	0.30	0.30	0.30	0.30	
Quantity Unit:	Each	Each	Each	Each	
LifeSafety Hazard:					
Potential non-collapse casualties? (Yes / No)	NO	NO	NO	NO	
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable	Not Applicable	Not Applicable	Not Applicable	
Serious Injury (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00	0% 0.00	
Loss of Life (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00	0% 0.00	
Post-event Tagging Flag:	NO	NO	NO	NO	
Unsafe Placard Trigger (Median, Dispersion)	0% 0.00	0% 0.00	0% 0.00	0% 0.00	
Comments:	None				
Date Created:	Not Given				
Approved (YES / NO)?	By User				
Official (YES / NO) ?	By User				
Author:	Not Given				
Revisions:	None				

Root Cost Multiplier: 1

Not Given
By User
By User
Not Given
None

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5092.033g

Diesel generator - Capacity: 750 to 1200 kVA - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragility only

Costing is per unit and is based upon 1000 kVA.

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

KV 1000

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

MutEx(DS1,DS2)

Anchorage failure.

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

Allow sum by floor or building?

Demand Location (floor above?)

YES

BLDG

No

Illustrations



D5092.031a-DS1-1.JPG

none

Damage State Probability:

0.70

0.30

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β_t :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User

User to Calculate

User to Calculate

By User

NO

NO

Average

Average

Superior

Superior

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Long Lead Time (Yes / No)

YES

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.40E+03

2.20E+03

3.10E+03

3.25E+05

3.82E+05

4.99E+05

2.23E+03

Normal

1.00

5.00

1.00

5.00

2.86E+03

1.98E+03

4.97E+05

3.44E+05

0.30

0.30

0.17

0.17

Each

Each

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

P₁₀

P₅₀

P₉₀

1.44E+00

2.26E+00

3.19E+00

3.34E+01

3.94E+01

5.13E+01

2.26E+00

Normal

1.00

5.00

1.00

5.00

2.94E+00

2.04E+00

1.57E+02

1.97E+01

0.39

0.39

0.30

0.30

Each

Each

NO

NO

Not Applicable

Not Applicable

0%

0.00

0%

0.00

0%

0.00

NO

NO

0%

0.00

0%

0.00

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Not Given

By User

By User

Not Given

None

Root Cost Multiplier:

1

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5092.033j

Diesel generator - Capacity: 1200 to 2000 kVa - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Anchorage fragility only

Costing is per unit and is based upon 1500 kVa.

Line 669

Construction Quality:

Seismic Installation Conditions:

Fragility Unit of Measure:

Demand Parameter (unit):

Number of Damage States:

Damage State:

Type of Damage State:

DS Hierarchy

Descriptions

Normal - Designed for seismic loads but no special seismic certification

Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints

KV 1500

Peak Floor Acceleration

g

2

DS1

DS2

Mutually Exclusive

MutEx(DS1,DS2)

Anchorage failure.

Mutually Exclusive

Anchorage failure & Equipment damaged beyond repair.

Quantity Rounding

Round Qty?

YES

Allow sum by floor or building?

BLDG

Demand Location (floor above?)

No

Illustrations



D5092.031a-DS1-1.JPG

none

Damage State Probability:

0.70

0.30

Fragility Parameters

Median Demand, θ :

Data dispersion, β_d :

Uncertainty, β_u :

Total Dispersion, β_t :

Correlation (Yes / No)

Directionality (Yes / No)

Quality Ratings

Data Quality

Data Relevance

Documentation Quality

Rationality

Consequence Functions

Repair Description

By User

User to Calculate

User to Calculate

By User

By User

User to Calculate

User to Calculate

By User

NO

NO

Average

Average

Superior

Superior

Repair anchorage and concrete pad and remount equipment.

Replace equipment including attached utilities in addition to repairing anchorage and concrete pad.

Long Lead Time (Yes / No)

YES

YES

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
1.60E+03	2.40E+03	3.40E+03	4.84E+05	5.71E+05	7.43E+05												
2.36E+03			5.80E+05														
LogNormal			LogNormal														
1.00		5.00	1.00		5.00												
3.12E+03		2.16E+03	7.42E+05		5.14E+05												
0.29		0.29	0.17		0.17												
Each			Each														
P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}	P_{10}	P_{50}	P_{90}
1.65E+00	2.47E+00	3.50E+00	3.49E+01	4.11E+01	5.36E+01												
2.47E+00			4.11E+01														
LogNormal			LogNormal														
1.00		5.00	1.00		5.00												
3.21E+00		2.22E+00	2.17E+02		2.06E+01												
0.38		0.38	0.30		0.30												
Each			Each														
NO			NO														
Not Applicable			Not Applicable														
0%		0.00	0%		0.00												
0%		0.00	0%		0.00												
NO			NO														
0%		0.00	0%		0.00												

User to provide median demand and dispersion values. The values listed are default PACT values and do not represent the response of this component.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name

Description

D5092.033k

Line 670


Diesel generator - Capacity: 1200 to 2000 kVa - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Equipment fragility only

Costing is per unit and is based upon 1500 kVa.

Construction Quality:	Normal - Designed for seismic loads but no special seismic certification			
Seismic Installation Conditions:	Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints			
Fragility Unit of Measure:	KV 1500			
Demand Parameter (unit):	Peak Floor Acceleration g			
Number of Damage States:	4			
Damage State:	DS1	DS2	DS3	DS4
Type of Damage State:	Mutually Exclusive		Mutually Exclusive	
DS Hierarchy	MutEx(DS1,DS2,DS3,DS4)			
Descriptions	Damaged, inoperative but anchorage is OK. Pipes and nozzles damaged.	Damaged, inoperative but anchorage is OK. Drive shaft misalignment.	Damaged, inoperative but anchorage is OK. Minor electrical damage, e.g., failed relay.	Damaged, inoperative but anchorage is OK. Exhaust line disconnected at expansion bellows.

Quantity Rounding	Round Qty?	YES
Allow sum by floor or building?		BLDG
Demand Location (floor above?)		No

Illustrations

				
D5092.031b-DS1-1.JPG	none	none	none	
0.70	0.10	0.10	0.10	

Damage State Probability:	0.70	0.10	0.10	0.10	
Fragility Parameters					
Median Demand, θ :	2	2	2	2	
Data dispersion, β_d :	0.2	0.20	0.2	0.2	
Uncertainty, β_u :	0.1	0.1	0.1	0.1	
Total Dispersion, β :	0.2	0.2	0.2	0.2	
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Average				
Data Relevance	Average				
Documentation Quality	Superior				
Rationality	Superior				
Consequence Functions					
Repair Description	Repair fracture pipes and damaged nozzles.	Overhaul because of drive shaft misalignment.	Minor electrical repair e.g., replace relay.	Reconnect exhaust line.	

Long Lead Time (Yes / No) YES YES YES YES

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	1.28E+03	1.50E+03	1.95E+03	8.50E+03	1.00E+04	1.30E+04	1.02E+03	1.20E+03	1.56E+03	1.02E+03	1.20E+03	1.56E+03			
Best fit mean:	1.55E+03			1.03E+04			1.24E+03			1.24E+03					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00	1.00		5.00			
Average Repair Cost (Min Qty, Max Qty)	1.65E+03		1.05E+03	1.10E+04		9.00E+03	1.32E+03		1.08E+03	1.32E+03		1.08E+03			
CV or beta (Min Qty, Max Qty)	0.17		0.17	0.17		0.17	0.17		0.17	0.17		0.17			
Quantity Unit:	Each			Each			Each			Each					
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	1.88E-01	2.21E-01	2.87E-01	1.25E+00	1.47E+00	1.91E+00	1.50E-01	1.77E-01	2.29E-01	1.50E-01	1.77E-01	2.29E-01			
Best fit mean:	2.21E-01			1.47E+00			1.77E-01			1.77E-01					
Best Fit Distribution:	LogNormal			LogNormal			LogNormal			LogNormal					
Quantity Plateau (Min Qty, Max Qty)	1.00		5.00	1.00		5.00	1.00		5.00	1.00		5.00			
Average Repair Time (Min Qty, Max Qty)	2.43E-01		1.54E-01	1.62E+00		1.32E+00	1.94E-01		1.59E-01	1.94E-01		1.59E-01			
CV or beta (Min Qty, Max Qty)	0.30		0.30	0.30		0.30	0.30		0.30	0.30		0.30			
Quantity Unit:	Each			Each			Each			Each					
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO			NO			NO			NO					
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable			Not Applicable			Not Applicable			Not Applicable					
Serious Injury (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00				
Loss of Life (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00				
Post-event Tagging Flag:	NO			NO			NO			NO					
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00		0%	0.00		0%	0.00		0%	0.00				
Comments:	None														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														
													Root Cost Multiplier:	1	

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification E2022.001
NISTIR Name Modular office work stations.
Description Unanchored and installed per manufacturer's recommendations on a carpeted floor.

Line 672

Construction Quality: Any

Seismic Installation Conditions: Unsecured

Fragility Unit of Measure: EA 1

Demand Parameter (unit): Peak Floor Acceleration g

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy Seq(DS1)

Descriptions Wall units need to be adjusted and straightened. Some elements are bent / damaged and need to be replaced.

Quantity Rounding Round Qty? NO

Allow sum by floor or building? NO

Demand Location (floor above?) No

Illustrations					
	none				

Damage State Probability: 1.00

Fragility Parameters

Median Demand, θ : 1

Data dispersion, β_d : Not Specified

Uncertainty, β_u : Not Specified

Total Dispersion, β : 0.4

Correlation (Yes / No) NO

Directionality (Yes / No) NO

Quality Ratings

Data Quality Not Rated

Data Relevance Not Rated

Documentation Quality Not Rated

Rationality Not Rated

Consequence Functions

Repair Description Adjust and or straightened wall units. Replace damaged units. Assume a repair cost of 5% of the replacement value.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER	BY USER												
Best Fit Distribution:	BY USER	BY USER	BY USER												
Quantity Plateau (Min Qty, Max Qty)	BY USER		BY USER												
Average Repair Cost (Min Qty, Max Qty)	BY USER		BY USER												
CV or beta (Min Qty, Max Qty)	BY USER		BY USER												
Quantity Unit:	BY USER														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER	BY USER												
Best Fit Distribution:	BY USER	BY USER	BY USER												
Quantity Plateau (Min Qty, Max Qty)	BY USER		BY USER												
Average Repair Time (Min Qty, Max Qty)	BY USER		BY USER												
CV or beta (Min Qty, Max Qty)	BY USER		BY USER												
Quantity Unit:	BY USER														
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	This component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent actual consequence.														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification E2022.010
NISTIR Name Unsecured fragile objects on shelves, unknown restraint
Description Costing to be furnished by user. Consequence data assumes 16 SF of damage area.

Line 673

Construction Quality: Any

Seismic Installation Conditions: Unknown conditions: some objects may have museum putty. Some cabinets may have latches. Some cabinets may be secured.

Frangility Unit of Measure: EA 1

Demand Parameter (unit): Peak Floor Acceleration g

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy Seq(DS1)

Descriptions Object falls off shelf or shelf overturns and object breaks or object breaks within cabinet.

Quantity Rounding Round Qty? NO

Allow sum by floor or building? NO

Demand Location (floor above?) No

Illustrations

E2022.010-DS1-1.JPG

Damage State Probability: 1.00

Frangility Parameters

Median Demand, θ : 0.4

Data dispersion, β_d : 0.4

Uncertainty, β_u : 0.3

Total Dispersion, β : 0.6

Correlation (Yes / No) NO

Directionality (Yes / No) NO

Quality Ratings

Data Quality Not Rated

Data Relevance Not Rated

Documentation Quality Not Rated

Rationality Not Rated

Consequence Functions

Repair Description Replace object. Note: user must supply cost of replacement.

Long Lead Time (Yes / No) NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Cost (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty)

Average Repair Time (Min Qty, Max Qty)

CV or beta (Min Qty, Max Qty)

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No)

Casualty-affected Planar Area (sf) per Normative Unit:

Serious Injury (Median, Dispersion)

Loss of Life (Median, Dispersion)

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion)

Comments:

Date Created:

Approved (YES / NO)?

Official (YES / NO) ?

Author:

Revisions:

This component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent actual consequence.

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification E2022.012
NISTIR Name Fragile contents on shelves in storage cabinets with latches
Description Costing to be furnished by user. Consequence data assumes 16 SF of damage area.

Line 675

Construction Quality: Any

Seismic Installation Conditions: In secured cabinets (e.g., with latches)

Fragility Unit of Measure: EA 1

Demand Parameter (unit): Peak Floor Acceleration g

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1)


Descriptions: Object falls off shelf or shelf overturns and object breaks or object breaks within cabinet.

Quantity Rounding: Round Qty? NO

Allow sum by floor or building? NO

Demand Location (floor above?) No

Illustrations



E2022.010-DS1-1.JPG

Damage State Probability: 1.00

Fragility Parameters

Median Demand, θ : 0.6

Data dispersion, β_d : 0.5

Uncertainty, β_u : 0.3

Total Dispersion, β : 0.6

Correlation (Yes / No): NO

Directionality (Yes / No): NO

Quality Ratings

Data Quality: Not Rated

Data Relevance: Not Rated

Documentation Quality: Not Rated

Rationality: Not Rated

Consequence Functions

Repair Description: Replace object. Note: user must supply cost of replacement.

Long Lead Time (Yes / No) NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty): BY USER

Average Repair Cost (Min Qty, Max Qty): BY USER

CV or beta (Min Qty, Max Qty): BY USER

Quantity Unit: BY USER

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty): BY USER

Average Repair Time (Min Qty, Max Qty): BY USER

CV or beta (Min Qty, Max Qty): BY USER

Quantity Unit: BY USER

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No): YES

Casualty-affected Planar Area (sf) per Normative Unit: 16 SF

Serious Injury (Median, Dispersion): 5% 0.50

Loss of Life (Median, Dispersion): 0% 0.00

Post-event Tagging Flag: NO

Unsafe Placard Trigger (Median, Dispersion): 0% 0.00

Comments: This component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent actual consequence.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO)? By User

Author: Not Given

Revisions: None

Root Cost Multiplier: 1

Date Created:	Not Given	Root Cost Multiplier: 1
Approved (YES / NO)?	By User	
Official (YES / NO) ?	By User	
Author:	Not Given	
Revisions:	None	

FEMA P-58 Fragility Specification

NISTIR Classification E2022.021
NISTIR Name Electronic equipment on wall mount brackets
Description Costing to be furnished by user. Consequence data assumes 16 SF of damage area.

Line 678

Construction Quality: Any

Seismic Installation Conditions: Unsecured

Fragility Unit of Measure: EA 1

Demand Parameter (unit): Peak Floor Acceleration g

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1)


Descriptions: Falls, does not function.

Quantity Rounding: Round Qty? NO

Allow sum by floor or building? NO

Demand Location (floor above?) No

Illustrations



E2022.020-DS1-1.JPG

Damage State Probability: 1.00

Fragility Parameters

Median Demand, θ : 2.5

Data dispersion, β_d : 0.4

Uncertainty, β_u : 0.3

Total Dispersion, β : 0.5

Correlation (Yes / No): NO

Directionality (Yes / No): NO

Quality Ratings

Data Quality: Not Rated

Data Relevance: Not Rated

Documentation Quality: Not Rated

Rationality: Not Rated

Consequence Functions

Repair Description: Replace equipment. User must supply replacement cost.

Long Lead Time (Yes / No) NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty): BY USER

Average Repair Cost (Min Qty, Max Qty): BY USER

CV or beta (Min Qty, Max Qty): BY USER

Quantity Unit: BY USER

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty): BY USER

Average Repair Time (Min Qty, Max Qty): BY USER

CV or beta (Min Qty, Max Qty): BY USER

Quantity Unit: BY USER

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No): YES

Casualty-affected Planar Area (sf) per Normative Unit: 16 SF

Serious Injury (Median, Dispersion): 20% 0.50

Loss of Life (Median, Dispersion): 10% 0.50

Post-event Tagging Flag: NO

Unsafe Placard Trigger (Median, Dispersion): 0% 0.00

Comments: This component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent actual consequence.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO)? By User

Author: Not Given

Revisions: None

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

E2022.022

Desktop electronics including computers, monitors, stereos, etc on a slip resistant surface
Costing to be furnished by user. Consequence data assumes 16 SF of damage area.

Line 679

Construction Quality: Any

Seismic Installation Conditions: Unsecured

Fragility Unit of Measure: EA 1

Demand Parameter (unit): Peak Floor Acceleration g

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1)

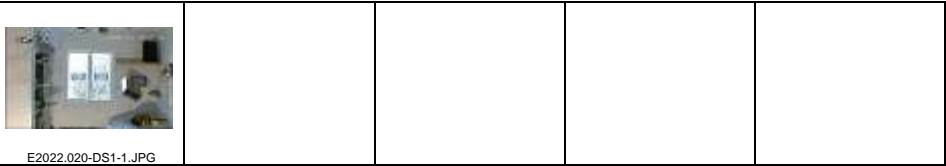
Descriptions: Falls, does not function.

Quantity Rounding: Round Qty? NO

Allow sum by floor or building? NO

Demand Location (floor above?) No

Illustrations



Damage State Probability: 1.00

Fragility Parameters

Median Demand, θ : 1

Data dispersion, β_d : 0.4

Uncertainty, β_u : 0.3

Total Dispersion, β : 0.5

Correlation (Yes / No): NO

Directionality (Yes / No): NO

Quality Ratings

Data Quality: Not Rated

Data Relevance: Not Rated

Documentation Quality: Not Rated

Rationality: Not Rated

Consequence Functions

Repair Description: Replace equipment. User must supply replacement cost.

Long Lead Time (Yes / No) NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty): BY USER

Average Repair Cost (Min Qty, Max Qty): BY USER

CV or beta (Min Qty, Max Qty): BY USER

Quantity Unit: BY USER

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty): BY USER

Average Repair Time (Min Qty, Max Qty): BY USER

CV or beta (Min Qty, Max Qty): BY USER

Quantity Unit: BY USER

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No): YES

Casualty-affected Planar Area (sf) per Normative Unit: 16 SF

Serious Injury (Median, Dispersion): 10% 0.50

Loss of Life (Median, Dispersion): 0% 0.00

Post-event Tagging Flag:

Unsafe Placard Trigger (Median, Dispersion): 0% 0.00

Comments: This component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent actual consequence.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO)? By User

Author: Not Given

Revisions: None

Root Cost Multiplier: 1

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification E2022.103a
NISTIR Name Bookcase, 3 shelves, unanchored laterally
Description Standard bookcase, unanchored laterally. Bookcase is 12-5/8" deep x 41" tall

Line 683

Construction Quality: Normal

Seismic Installation Conditions: Unsecured

Fragility Unit of Measure: EA 1

Demand Parameter (unit): Peak Floor Velocity meter/sec

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1)

Descriptions: Book case falls over and contents are scattered. Likely damage to bookcase.

Quantity Rounding: NO

Round Qty?: NO

Allow sum by floor or building?: NO

Demand Location (floor above?): No

Illustrations

none

1.00

Fragility Parameters

Median Demand, θ : 0.493

Data dispersion, β_d : User to Calculate

Uncertainty, β_u : User to Calculate

Total Dispersion, β : 0.5

Correlation (Yes / No): NO

Directionality (Yes / No): NO

Quality Ratings

Data Quality: Not Rated

Data Relevance: Not Rated

Documentation Quality: Not Rated

Rationality: Not Rated

Consequence Functions

Repair Description: Replace bookcase and restack / replace contents.

Long Lead Time (Yes / No) NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty): BY USER

Average Repair Cost (Min Qty, Max Qty): BY USER

CV or beta (Min Qty, Max Qty): BY USER

Quantity Unit:

BY USER

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty): BY USER

Average Repair Time (Min Qty, Max Qty): BY USER

CV or beta (Min Qty, Max Qty): BY USER

Quantity Unit:

BY USER

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No): NO

Casualty-affected Planar Area (sf) per Normative Unit: Not Applicable

Serious Injury (Median, Dispersion): 0% 0.00

Loss of Life (Median, Dispersion): 0% 0.00

Post-event Tagging Flag: NO

Unsafe Placard Trigger (Median, Dispersion): 0% 0.00

Comments: the ground motion only. This component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: None

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification E2022.103b
NISTIR Name Bookcase, 3 shelves, anchored laterally
Description Standard bookcase, anchored laterally. Bookcase is 12-5/8" deep x 41" tall.

Line 684

Construction Quality: Normal

Seismic Installation Conditions: Secured

Fragility Unit of Measure: EA 1

Demand Parameter (unit): Peak Floor Acceleration g

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1)

Descriptions: Book case falls over and contents are scattered. Likely damage to bookcase.

Quantity Rounding: Round Qty? NO

Allow sum by floor or building? NO

Demand Location (floor above?) No

Illustrations

none

1.00

Fragility Parameters

Median Demand, θ : By User

Data dispersion, β_d : User to Calculate

Uncertainty, β_u : User to Calculate

Total Dispersion, β : By User

Correlation (Yes / No): NO

Directionality (Yes / No): NO

Quality Ratings

Data Quality: Not Rated

Data Relevance: Not Rated

Documentation Quality: Not Rated

Rationality: Not Rated

Consequence Functions

Repair Description: Replace bookcase and restack / replace contents.

Long Lead Time (Yes / No) NO

Repair Costs:

Repair Cost by Damage State: BY USER BY USER BY USER

Best fit mean: BY USER

Best Fit Distribution: BY USER

Quantity Plateau (Min Qty, Max Qty): BY USER BY USER

Average Repair Cost (Min Qty, Max Qty): BY USER BY USER

CV or beta (Min Qty, Max Qty): BY USER BY USER

Quantity Unit: BY USER

Repair Time:

Repair Time by Damage State: BY USER BY USER BY USER

Best fit mean: BY USER

Best Fit Distribution: BY USER

Quantity Plateau (Min Qty, Max Qty): BY USER BY USER

Average Repair Time (Min Qty, Max Qty): BY USER BY USER

CV or beta (Min Qty, Max Qty): BY USER BY USER

Quantity Unit: BY USER

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No): NO

Casualty-affected Planar Area (sf) per Normative Unit: Not Applicable

Serious Injury (Median, Dispersion): 0% 0.00

Loss of Life (Median, Dispersion): 0% 0.00

Post-event Tagging Flag: NO

Unsafe Placard Trigger (Median, Dispersion): 0% 0.00

Comments: component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent actual consequence.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: None

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification E2022.104a
NISTIR Name Bookcase, 4 shelves, unanchored laterally
Description Standard bookcase, unanchored laterally. Bookcase is 12-5/8" deep x 56" tall

Line 685

Construction Quality: Normal

Seismic Installation Conditions: Unsecured

Fragility Unit of Measure: EA 1

Demand Parameter (unit): Peak Floor Velocity meter/sec

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1)

Descriptions: Book case falls over and contents are scattered. Likely damage to bookcase.

Quantity Rounding: Round Qty? NO

Allow sum by floor or building? NO

Demand Location (floor above?) No

Illustrations

none

1.00

Fragility Parameters

Median Demand, θ : 0.361

Data dispersion, β_d : User to Calculate

Uncertainty, β_u : User to Calculate

Total Dispersion, β : 0.5

Correlation (Yes / No): NO

Directionality (Yes / No): NO

Quality Ratings

Data Quality: Not Rated

Data Relevance: Not Rated

Documentation Quality: Not Rated

Rationality: Not Rated

Consequence Functions

Repair Description: Replace bookcase and restack / replace contents.

Long Lead Time (Yes / No) NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty): BY USER

Average Repair Cost (Min Qty, Max Qty): BY USER

CV or beta (Min Qty, Max Qty): BY USER

Quantity Unit:

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty): BY USER

Average Repair Time (Min Qty, Max Qty): BY USER

CV or beta (Min Qty, Max Qty): BY USER

Quantity Unit:

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No): NO

Casualty-affected Planar Area (sf) per Normative Unit: Not Applicable

Serious Injury (Median, Dispersion): 0% 0.00

Loss of Life (Median, Dispersion): 0% 0.00

Post-event Tagging Flag: NO

Unsafe Placard Trigger (Median, Dispersion): 0% 0.00

Comments: the ground motion only. This component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: None

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification E2022.104b
NISTIR Name Bookcase, 4 shelves, anchored laterally
Description Standard bookcase, anchored laterally. Bookcase is 12-5/8" deep x 56" tall.

Line 686

Construction Quality: Normal

Seismic Installation Conditions: Secured

Fragility Unit of Measure: EA 1

Demand Parameter (unit): Peak Floor Acceleration g

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1)

Descriptions: Book case falls over and contents are scattered. Likely damage to bookcase.

Quantity Rounding: Round Qty? NO

Allow sum by floor or building? NO

Demand Location (floor above?) No

Illustrations					
	none				
	1.00				

Damage State Probability: 1.00

Fragility Parameters

Median Demand, θ : By User

Data dispersion, β_d : User to Calculate

Uncertainty, β_u : User to Calculate

Total Dispersion, β : By User

Correlation (Yes / No): NO

Directionality (Yes / No): NO

Quality Ratings

Data Quality: Not Rated

Data Relevance: Not Rated

Documentation Quality: Not Rated

Rationality: Not Rated

Consequence Functions

Repair Description: Replace bookcase and restack / replace contents.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER	BY USER												
Best Fit Distribution:	BY USER	BY USER	BY USER												
Quantity Plateau (Min Qty, Max Qty)	BY USER		BY USER												
Average Repair Cost (Min Qty, Max Qty)	BY USER		BY USER												
CV or beta (Min Qty, Max Qty)	BY USER		BY USER												
Quantity Unit:	BY USER		BY USER												
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER	BY USER												
Best Fit Distribution:	BY USER	BY USER	BY USER												
Quantity Plateau (Min Qty, Max Qty)	BY USER		BY USER												
Average Repair Time (Min Qty, Max Qty)	BY USER		BY USER												
CV or beta (Min Qty, Max Qty)	BY USER		BY USER												
Quantity Unit:	BY USER		BY USER												
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)		NO													
Casualty-affected Planar Area (sf) per Normative Unit:		Not Applicable													
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:		NO													
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent actual consequence.														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification E2022.105b
NISTIR Name Bookcase, 5 shelves, anchored laterally
Description Standard bookcase, anchored laterally. Bookcase is 12-5/8" deep x 71" tall.

Line 688

Construction Quality: Normal

Seismic Installation Conditions: Secured

Fragility Unit of Measure: EA 1

Demand Parameter (unit): Peak Floor Acceleration g

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1)

Descriptions: Book case falls over and contents are scattered. Likely damage to bookcase.

Quantity Rounding: Round Qty? NO

Allow sum by floor or building? NO

Demand Location (floor above?) No

Illustrations					
	none				
	1.00				

Damage State Probability: 1.00

Fragility Parameters

Median Demand, θ : By User

Data dispersion, β_d : User to Calculate

Uncertainty, β_u : User to Calculate

Total Dispersion, β : By User

Correlation (Yes / No): NO

Directionality (Yes / No): NO

Quality Ratings

Data Quality: Not Rated

Data Relevance: Not Rated

Documentation Quality: Not Rated

Rationality: Not Rated

Consequence Functions

Repair Description: Replace bookcase and restack / replace contents.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER													
Average Repair Cost (Min Qty, Max Qty)	BY USER	BY USER													
CV or beta (Min Qty, Max Qty)	BY USER	BY USER													
Quantity Unit:	BY USER														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER													
Average Repair Time (Min Qty, Max Qty)	BY USER	BY USER													
CV or beta (Min Qty, Max Qty)	BY USER	BY USER													
Quantity Unit:	BY USER														
LifeSafety Hazard:		YES													
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:		10 SF													
Serious Injury (Median, Dispersion)	By User	0.50													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:		NO													
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent actual consequence.														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification E2022.106b
NISTIR Name Bookcase, 6 shelves, anchored laterally
Description Standard bookcase, anchored laterally. Bookcase is 12-5/8" deep x 81-1/4" tall.

Line 690

Construction Quality: Normal

Seismic Installation Conditions: Secured

Fragility Unit of Measure: EA 1

Demand Parameter (unit): Peak Floor Acceleration g

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1)

Descriptions: Book case falls over and contents are scattered. Likely damage to bookcase.

Quantity Rounding: Round Qty? NO

Allow sum by floor or building? NO

Demand Location (floor above?) No

Illustrations

none

1.00

Fragility Parameters

Median Demand, θ : By User

Data dispersion, β_d : User to Calculate

Uncertainty, β_u : User to Calculate

Total Dispersion, β : By User

Correlation (Yes / No): NO

Directionality (Yes / No): NO

Quality Ratings

Data Quality: Not Rated

Data Relevance: Not Rated

Documentation Quality: Not Rated

Rationality: Not Rated

Consequence Functions

Repair Description: Replace bookcase and restack / replace contents.

Long Lead Time (Yes / No) NO

Repair Costs:

Repair Cost by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty): BY USER

Average Repair Cost (Min Qty, Max Qty): BY USER

CV or beta (Min Qty, Max Qty): BY USER

Quantity Unit: BY USER

Repair Time:

Repair Time by Damage State:

Best fit mean:

Best Fit Distribution:

Quantity Plateau (Min Qty, Max Qty): BY USER

Average Repair Time (Min Qty, Max Qty): BY USER

CV or beta (Min Qty, Max Qty): BY USER

Quantity Unit: BY USER

LifeSafety Hazard:

Potential non-collapse casualties? (Yes / No): YES

Casualty-affected Planar Area (sf) per Normative Unit: 20 SF

Serious Injury (Median, Dispersion): By User 0.50

Loss of Life (Median, Dispersion): 0% 0.00

Post-event Tagging Flag: NO

Unsafe Placard Trigger (Median, Dispersion): 0% 0.00

Comments: component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent actual consequence.

Date Created: Not Given

Approved (YES / NO)? By User

Official (YES / NO) ? By User

Author: Not Given

Revisions: None

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification E2022.112a
NISTIR Name Vertical Filing Cabinet, 2 drawer, unanchored laterally
Description Filing cabinet, unanchored laterally. Cabinet has 2 drawers and is 15" deep x 24" tall

Line 691

Construction Quality:	Normal				
Seismic Installation Conditions:	Unsecured				
Fragility Unit of Measure:	EA 1				
Demand Parameter (unit):	Peak Floor Velocity	meter/sec			
Number of Damage States:	1				
Damage State:	DS1				
Type of Damage State:	Sequential				
DS Hierarchy	Seq(DS1)				
Descriptions	Filing cabinet falls over and contents are scattered. Likely damage to file cabinet.				

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none				
Damage State Probability:	1.00				

Fragility Parameters					
Median Demand, θ :	1.229				
Data dispersion, β_d :	User to Calculate				
Uncertainty, β_u :	User to Calculate				
Total Dispersion, β :	0.5				
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Replace filing cabinet and refill / replace contents.				

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER													
Average Repair Cost (Min Qty, Max Qty)	BY USER	BY USER													
CV or beta (Min Qty, Max Qty)	BY USER	BY USER													
Quantity Unit:	BY USER														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER													
Average Repair Time (Min Qty, Max Qty)	BY USER	BY USER													
CV or beta (Min Qty, Max Qty)	BY USER	BY USER													
Quantity Unit:	BY USER														
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	the ground motion only. This component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification E2022.112b
NISTIR Name Vertical Filing Cabinet, 2 drawer, anchored laterally
Description Filing cabinet, anchored laterally. Cabinet has 2 drawers and is 15" deep x 24" tall

Line 692

Construction Quality:	Normal					Quantity Rounding	Round Qty?	NO	
Seismic Installation Conditions:	Secured					Allow sum by floor or building?			NO
Fragility Unit of Measure:	EA 1					Demand Location (floor above?)			No
Demand Parameter (unit):	Peak Floor Velocity	meter/sec							
Number of Damage States:	1								
Damage State:	DS1								
Type of Damage State:	Sequential								
DS Hierarchy	Seq(DS1)								
Descriptions	Filing cabinet falls over and contents are scattered. Likely damage to file cabinet.								

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none				
	1.00				

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	By User				
Data dispersion, β_d :	User to Calculate				
Uncertainty, β_u :	User to Calculate				
Total Dispersion, β :	By User				
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Replace filing cabinet and refill / replace contents.				

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER													
Average Repair Cost (Min Qty, Max Qty)	BY USER	BY USER													
CV or beta (Min Qty, Max Qty)	BY USER	BY USER													
Quantity Unit:	BY USER														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER													
Average Repair Time (Min Qty, Max Qty)	BY USER	BY USER													
CV or beta (Min Qty, Max Qty)	BY USER	BY USER													
Quantity Unit:	BY USER														
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)	NO														
Casualty-affected Planar Area (sf) per Normative Unit:	Not Applicable														
Serious Injury (Median, Dispersion)	0%	0.00													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:	NO														
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent actual consequence.														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification E2022.114a
NISTIR Name Vertical Filing Cabinet, 4 drawer, unanchored laterally
Description Filing cabinet, unanchored laterally. Cabinet has 4 drawers and is 15" deep x 52" tall

Line 693

Construction Quality:	Normal					Quantity Rounding	Round Qty?	NO
Seismic Installation Conditions:	Unsecured							
Fragility Unit of Measure:	EA 1							
Demand Parameter (unit):	Peak Floor Velocity	meter/sec						
Number of Damage States:	1					Allow sum by floor or building?	NO	
Damage State:	DS1					Demand Location (floor above?)	No	
Type of Damage State:	Sequential							
DS Hierarchy	Seq(DS1)							
Descriptions	Filing cabinet falls over and contents are scattered. Likely damage to file cabinet.							

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none				
Damage State Probability:	1.00				

Fragility Parameters					
Median Demand, θ :	0.498				
Data dispersion, β_d :	User to Calculate				
Uncertainty, β_u :	User to Calculate				
Total Dispersion, β :	0.5				
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Replace filing cabinet and refill / replace contents.				

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER													
Average Repair Cost (Min Qty, Max Qty)	BY USER	BY USER													
CV or beta (Min Qty, Max Qty)	BY USER	BY USER													
Quantity Unit:	BY USER														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER													
Average Repair Time (Min Qty, Max Qty)	BY USER	BY USER													
CV or beta (Min Qty, Max Qty)	BY USER	BY USER													
Quantity Unit:	BY USER														
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)		YES													
Casualty-affected Planar Area (sf) per Normative Unit:		10 SF													
Serious Injury (Median, Dispersion)	By User	0.50													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:		NO													
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	the ground motion only. This component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification E2022.114b
NISTIR Name Vertical Filing Cabinet, 4 drawer, anchored laterally
Description Filing cabinet, anchored laterally. Cabinet has 4 drawers and is 15" deep x 52" tall

Line 694

Construction Quality:	Normal				<div>Quantity Rounding</div> <div>Round Qty?</div> <div>NO</div> <div>Allow sum by floor or building?</div> <div>NO</div> <div>Demand Location (floor above?)</div> <div>No</div>	
Seismic Installation Conditions:	Secured					
Fragility Unit of Measure:	EA 1					
Demand Parameter (unit):	Peak Floor Velocity	meter/sec				
Number of Damage States:	1					
Damage State:	DS1					
Type of Damage State:	Sequential					
DS Hierarchy	Seq(DS1)					
Descriptions	Filing cabinet falls over and contents are scattered. Likely damage to file cabinet.					

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none				
	1.00				

Damage State Probability:					
Fragility Parameters					
Median Demand, θ :	By User				
Data dispersion, β_d :	User to Calculate				
Uncertainty, β_u :	User to Calculate				
Total Dispersion, β :	By User				
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Replace filing cabinet and refill / replace contents.				

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER	BY USER												
Best Fit Distribution:	BY USER	BY USER	BY USER												
Quantity Plateau (Min Qty, Max Qty)	BY USER		BY USER												
Average Repair Cost (Min Qty, Max Qty)	BY USER		BY USER												
CV or beta (Min Qty, Max Qty)	BY USER		BY USER												
Quantity Unit:	BY USER														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER	BY USER												
Best Fit Distribution:	BY USER	BY USER	BY USER												
Quantity Plateau (Min Qty, Max Qty)	BY USER		BY USER												
Average Repair Time (Min Qty, Max Qty)	BY USER		BY USER												
CV or beta (Min Qty, Max Qty)	BY USER		BY USER												
Quantity Unit:	BY USER														
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)		YES													
Casualty-affected Planar Area (sf) per Normative Unit:		10 SF													
Serious Injury (Median, Dispersion)	By User	0.50													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:		NO													
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent actual consequence.														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification E2022.124a
NISTIR Name Lateral Filing Cabinet, 2 drawer, unanchored laterally
Description Filing cabinet, unanchored laterally. Cabinet has 4 drawers and is 18.6" deep x 52.5" tall

Line 695

Construction Quality:	Normal					Quantity Rounding Round Qty? NO Allow sum by floor or building? NO Demand Location (floor above?) No
Seismic Installation Conditions:	Unsecured					
Fragility Unit of Measure:	EA 1					
Demand Parameter (unit):	Peak Floor Velocity	meter/sec				
Number of Damage States:	1					
Damage State:	DS1					
Type of Damage State:	Sequential					
DS Hierarchy	Seq(DS1)					
Descriptions	Filing cabinet falls over and contents are scattered. Likely damage to file cabinet.					

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none				
Damage State Probability:	1.00				

Fragility Parameters					
Median Demand, θ :	0.688				
Data dispersion, β_d :	User to Calculate				
Uncertainty, β_u :	User to Calculate				
Total Dispersion, β :	0.5				
Correlation (Yes / No)		NO			
Directionality (Yes / No)		NO			
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description		Replace filing cabinet and refill / replace contents.			

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER													
Average Repair Cost (Min Qty, Max Qty)	BY USER	BY USER													
CV or beta (Min Qty, Max Qty)	BY USER	BY USER													
Quantity Unit:	BY USER														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER													
Average Repair Time (Min Qty, Max Qty)	BY USER	BY USER													
CV or beta (Min Qty, Max Qty)	BY USER	BY USER													
Quantity Unit:	BY USER														
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)		YES													
Casualty-affected Planar Area (sf) per Normative Unit:		10 SF													
Serious Injury (Median, Dispersion)	By User	0.50													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:		NO													
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	the ground motion only. This component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification E2022.124b
NISTIR Name Lateral Filing Cabinet, 2 drawer, anchored laterally
Description Filing cabinet, anchored laterally. Cabinet has 4 drawers and is 18.6" deep x 52.5" tall

Line 696

Construction Quality: Normal

Seismic Installation Conditions: Secured

Fragility Unit of Measure: EA 1

Demand Parameter (unit): Peak Floor Acceleration g

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1)

Descriptions: Filing cabinet falls over and contents are scattered. Likely damage to file cabinet.

Quantity Rounding: NO

Round Qty?: NO

Allow sum by floor or building?: NO

Demand Location (floor above?): No

Illustrations					
	none				
	1.00				

Damage State Probability: 1.00

Fragility Parameters

Median Demand, θ : By User

Data dispersion, β_d : User to Calculate

Uncertainty, β_u : User to Calculate

Total Dispersion, β : By User

Correlation (Yes / No): NO

Directionality (Yes / No): NO

Quality Ratings

Data Quality: Not Rated

Data Relevance: Not Rated

Documentation Quality: Not Rated

Rationality: Not Rated

Consequence Functions

Repair Description: Replace filing cabinet and refill / replace contents.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER													
Average Repair Cost (Min Qty, Max Qty)	BY USER	BY USER													
CV or beta (Min Qty, Max Qty)	BY USER	BY USER													
Quantity Unit:	BY USER														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER													
Average Repair Time (Min Qty, Max Qty)	BY USER	BY USER													
CV or beta (Min Qty, Max Qty)	BY USER	BY USER													
Quantity Unit:	BY USER														
LifeSafety Hazard:		YES													
Potential non-collapse casualties? (Yes / No)															
Casualty-affected Planar Area (sf) per Normative Unit:		10 SF													
Serious Injury (Median, Dispersion)	By User	0.50													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:		NO													
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent actual consequence.														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification E2022.125a
NISTIR Name Lateral Filing Cabinet, 4 drawer, unanchored laterally
Description Filing cabinet, unanchored laterally. Cabinet has 5 drawers and is 18.6" deep x 67.75" tall

Line 697

Construction Quality:	Normal		Quantity Rounding		Round Qty?	NO
Seismic Installation Conditions:	Unsecured		Allow sum by floor or building?		NO	
Fragility Unit of Measure:	EA 1		Demand Location (floor above?)		No	
Demand Parameter (unit):	Peak Floor Velocity	meter/sec				
Number of Damage States:	1					
Damage State:	DS1					
Type of Damage State:	Sequential					
DS Hierarchy	Seq(DS1)					
Descriptions	Filing cabinet falls over and contents are scattered. Likely damage to file cabinet.					

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations					
	none				
Damage State Probability:	1.00				

Fragility Parameters					
Median Demand, θ :	0.526				
Data dispersion, β_d :	User to Calculate				
Uncertainty, β_u :	User to Calculate				
Total Dispersion, β :	0.5				
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Not Rated				
Data Relevance	Not Rated				
Documentation Quality	Not Rated				
Rationality	Not Rated				
Consequence Functions					
Repair Description	Replace filing cabinet and refill / replace contents.				

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER													
Average Repair Cost (Min Qty, Max Qty)	BY USER	BY USER													
CV or beta (Min Qty, Max Qty)	BY USER	BY USER													
Quantity Unit:	BY USER														
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER													
Best Fit Distribution:	BY USER	BY USER													
Quantity Plateau (Min Qty, Max Qty)	BY USER	BY USER													
Average Repair Time (Min Qty, Max Qty)	BY USER	BY USER													
CV or beta (Min Qty, Max Qty)	BY USER	BY USER													
Quantity Unit:	BY USER														
LifeSafety Hazard:															
Potential non-collapse casualties? (Yes / No)		YES													
Casualty-affected Planar Area (sf) per Normative Unit:		20 SF													
Serious Injury (Median, Dispersion)	By User	0.50													
Loss of Life (Median, Dispersion)	0%	0.00													
Post-event Tagging Flag:		NO													
Unsafe Placard Trigger (Median, Dispersion)	0%	0.00													
Comments:	the ground motion only. This component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification E2022.125b
NISTIR Name Lateral Filing Cabinet, 4 drawer, anchored laterally
Description Filing cabinet, anchored laterally. Cabinet has 5 drawers and is 18.6" deep x 67.75" tall

Line 698

Construction Quality: Normal

Seismic Installation Conditions: Secured

Fragility Unit of Measure: EA 1

Demand Parameter (unit): Peak Floor Acceleration g

Number of Damage States: 1

Damage State: DS1

Type of Damage State: Sequential

DS Hierarchy: Seq(DS1)

Descriptions: Filing cabinet falls over and contents are scattered. Likely damage to file cabinet.

Quantity Rounding: NO

Round Qty?: NO

Allow sum by floor or building?: NO

Demand Location (floor above?): No

Illustrations					
	none				
	1.00				

Damage State Probability: 1.00

Fragility Parameters

Median Demand, θ : By User

Data dispersion, β_d : User to Calculate

Uncertainty, β_u : User to Calculate

Total Dispersion, β : By User

Correlation (Yes / No): NO

Directionality (Yes / No): NO

Quality Ratings

Data Quality: Not Rated

Data Relevance: Not Rated

Documentation Quality: Not Rated

Rationality: Not Rated

Consequence Functions

Repair Description: Replace filing cabinet and refill / replace contents.

Long Lead Time (Yes / No) NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Cost by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER	BY USER												
Best Fit Distribution:	BY USER	BY USER	BY USER												
Quantity Plateau (Min Qty, Max Qty)	BY USER		BY USER												
Average Repair Cost (Min Qty, Max Qty)	BY USER		BY USER												
CV or beta (Min Qty, Max Qty)	BY USER		BY USER												
Quantity Unit:	BY USER		BY USER												
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀
Repair Time by Damage State:	BY USER	BY USER	BY USER												
Best fit mean:	BY USER	BY USER	BY USER												
Best Fit Distribution:	BY USER	BY USER	BY USER												
Quantity Plateau (Min Qty, Max Qty)	BY USER		BY USER												
Average Repair Time (Min Qty, Max Qty)	BY USER		BY USER												
CV or beta (Min Qty, Max Qty)	BY USER		BY USER												
Quantity Unit:	BY USER		BY USER												
LifeSafety Hazard:			YES												
Potential non-collapse casualties? (Yes / No)			YES												
Casualty-affected Planar Area (sf) per Normative Unit:			20 SF												
Serious Injury (Median, Dispersion)	By User		0.50												
Loss of Life (Median, Dispersion)	0%		0.00												
Post-event Tagging Flag:			NO												
Unsafe Placard Trigger (Median, Dispersion)	0%		0.00												
Comments:	component requires user specified cost and time consequence data. Values within PACT are defaults (equal to zero) and do not represent actual consequence.														
Date Created:	Not Given														
Approved (YES / NO)?	By User														
Official (YES / NO) ?	By User														
Author:	Not Given														
Revisions:	None														

Root Cost Multiplier: 1

FEMA P-58 Fragility Specification

NISTIR Classification

NISTIR Name
Description

F1012.001

Storage racks designed and installed before 2007, big box retail (12' to 15' tall)
Standard pallet back to back storage rack. Three to five levels tall with total height from 15 to 20 ft. Costing assumes one single side access rack. Costing of rack and restocking based upon 50 LF of rack.
Costing of rack contents to be furnished by user.

Line 699

Construction Quality:	Normal				<div>Quantity RoundingRound Qty? NO</div> <div>Allow sum by floor or building? NO</div> <div>Demand Location (floor above)? No</div>
Seismic Installation Conditions:	Varies				
Fragility Unit of Measure:	LF 50				
Demand Parameter (unit):	Peak Floor Accelerationg				
Number of Damage States:	2				
Damage State:	DS1		DS2		
Type of Damage State:	Mutually Exclusive		Mutually Exclusive		
DS Hierarchy	MutEx(DS1,DS2)				
Descriptions	Significant merchandise shedding from rack shelves.		Significant structural damage to rack structure.		

Quantity Rounding	Round Qty?	NO
Allow sum by floor or building?		NO
Demand Location (floor above?)		No

Illustrations

				
F1012.001-DS1-1.JPG	F1012.001-DS2-1.JPG			

Damage State Probability:	0.60	0.40			
Fragility Parameters					
Median Demand, θ :	0.42	0.42			
Data dispersion, β_d :	User to Calculate	User to Calculate			
Uncertainty, β_u :	User to Calculate	User to Calculate			
Total Dispersion, β :	0.4	0.4			
Correlation (Yes / No)	NO				
Directionality (Yes / No)	NO				
Quality Ratings					
Data Quality	Average				
Data Relevance	Average				
Documentation Quality	Average				
Rationality	Average				
Consequence Functions					
Repair Description	Minor repair to storage rack. Resort and restock shelves. Clean up debris.				

Remove and replace storage rack system. Make minor repair to adjacent finishes. Resort and restock shelves. Clean up debris.

Long Lead Time (Yes / No)

NO

NO

Repair Costs:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀									
Repair Cost by Damage State:	2.15E+03	3.10E+03	5.20E+03	1.43E+04	1.87E+04	2.87E+04																		
Best fit mean:	3.24E+03			1.96E+04																				
Best Fit Distribution:	LogNormal			LogNormal																				
Quantity Plateau (Min Qty, Max Qty)	26.00		260.00	26.00		260.00																		
Average Repair Cost (Min Qty, Max Qty)	6.20E+03		1.86E+03	3.73E+04		1.12E+04																		
CV or beta (Min Qty, Max Qty)	0.36		0.36	0.29		0.29																		
Quantity Unit:	LF 50			LF 50																				
Repair Time:	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀	P ₁₀	P ₅₀	P ₉₀									
Repair Time by Damage State:	2.37E+00	3.42E+00	5.74E+00	1.57E+01	2.06E+01	3.17E+01																		
Best fit mean:	3.42E+00			2.06E+01																				
Best Fit Distribution:	LogNormal			LogNormal																				
Quantity Plateau (Min Qty, Max Qty)	26.00		260.00	26.00		260.00																		
Average Repair Time (Min Qty, Max Qty)	6.84E+00		2.05E+00	4.11E+01		1.23E+01																		
CV or beta (Min Qty, Max Qty)	0.44		0.44	0.38		0.38																		
Quantity Unit:	LF 50			LF 50																				
LifeSafety Hazard:																								
Potential non-collapse casualties? (Yes / No)	YES			YES																				
Casualty-affected Planar Area (sf) per Normative Unit:	By User			By User																				
Serious Injury (Median, Dispersion)	By User	By User		By User	By User																			
Loss of Life (Median, Dispersion)	By User	By User		By User	By User																			
Post-event Tagging Flag:	By User			By User																				
Unsafe Placard Trigger (Median, Dispersion)	By User	By User		By User	By User																			
Comments:	None																							
Date Created:	Not Given																							
Approved (YES / NO)?	By User																							
Official (YES / NO) ?	By User																							
Author:	Not Given																							
Revisions:	None																							

Root Cost Multiplier: 50